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# FRANKLIN JOURNAL,

AND

# AMERICAN MECHANICS' MAGAZINE;

**DEVOTED TO THE USEFUL ARTS,**

**INTERNAL IMPROVEMENTS, GENERAL SCIENCE,**

AND THE RECORDING OF AMERICAN AND OTHER PATENTED INVENTIONS.

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**JULY, 1828.**

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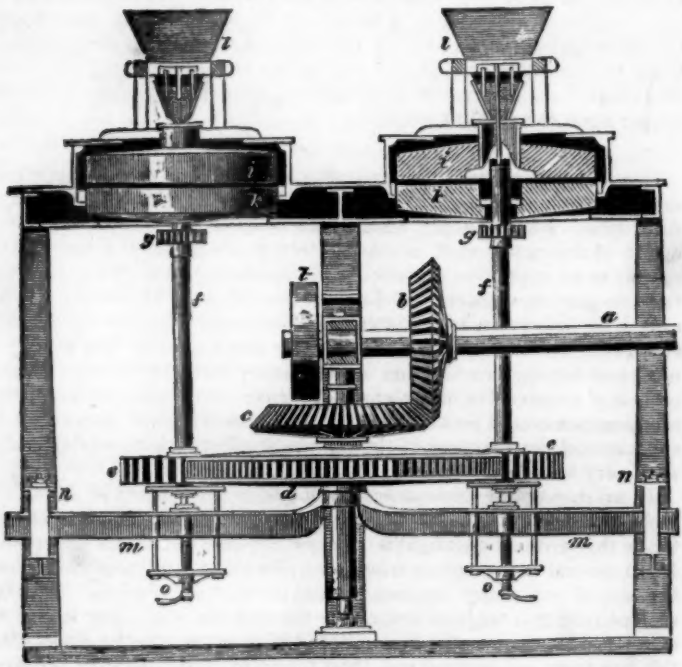
MR. HOBLYN'S MILL FOR HUSKING RICE.



*Account of the Island of Ceylon, its Agriculture, and the processes followed in several arts by the natives; with suggestions for their improvement.*

[Continued from p. 332, Vol. 5.]

We commenced the account of the arts, &c. in Ceylon in our last volume, by a recurrence to which it will be seen that the British government have encouraged the settlement of Europeans in that island. Mr. Hebert, the editor of the Register of Arts, has made many suggestions for the introduction of improved machinery, and new modes of procedure, which he has interspersed among the accounts of those now used by the Singalese; the present paper consists principally of these, but, in a future number, cuts of many other of the native instruments will be given. Among the machines recommended, will be found Barker's mill, of which the writer appears to think highly, and the *theory* of its action seems to warrant the opinion expressed; it, however, has been repeatedly tried, and as frequently abandoned, and considering the simplicity of its construction, and the directness of its action, which takes place without the intervention of gearing, we are forced to conclude, that it adds one to the list of those *practical* facts which manifest the imperfection of our theories on the motion of fluids: we think, however, that a careful investigation of the subject will furnish strong theoretical objections to this mode of applying the action of water; our views upon this subject shall hereafter be presented more at large than would be proper upon the present occasion.

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Our last paper was concluded with a description of the pestle and mortar in common use with the Singalese for husking and pounding their rice. For reducing *hard brittle* substances into powder, the action of the pestle and mortar is very potent, but the pestle and mortar is an apparatus so unsuited for operating upon raw grain, that the late governor-general of Ceylon, Sir Thomas Maitland, was induced, on his return to this country in the year 1812, strongly to recommend, to the Secretary of State for the Colonies, the taking of measures for the introduction of machinery into Ceylon that should be better adapted for the cleaning of rice. In consequence of this recommendation, Thomas Hoblyn, Esq. was officially instructed to superintend the carrying of the plan into effect, which was attended with very satisfactory results.

In an interesting communication made to the Society of Arts, Mr. Hoblyn observes that,—"instead of the *breaking* system, it occurred to me that trituration might be successful; and under this impression I had several experiments tried on grain-mills, and particularly on the sort of mill where oats are husked for making of grits. This answered tolerably well in detaching the outside sheli, but it had no effect whatever upon the fine cuticle which surrounds the grain, after this has been removed; it was then found necessary to have recourse

to some other plan to render the grain perfectly white, and after several ineffectual experiments, the mode now practised was that which was fixed upon as being the means of most effectually completing the process.

The mill consists of a strong framing, supporting by columns a platform about twelve feet square, and ten feet high; upon this platform there are placed, at equal distances, four pair of horizontal stones, four feet six inches diameter, driven by wheel-work contained under the platform, and supported by a framing of iron fixed to the columns. The mill is placed at about ten feet from the fly-wheel of the engine, and receives its motion by a shaft coupled on the end of that which carries the fly-wheel, having a bearing from its other end on the framing of the mill; on this shaft is a bevil or mitre-wheel four feet diameter, with cogs, working in another of the same size on an upright shaft in the very centre of the mill; there is also on this upright shaft a spur-wheel, seven feet diameter, working like the last-mentioned bevil-wheel, horizontally; this large wheel has cogs or teeth in its rim, which work into four pinions or small wheels, two feet six inches diameter, fitted on the spindles of the stones, and drives the four pair at once; all this wheel work is so proportioned, that when the engine makes thirty revolutions, the stone makes 84.

The under stone remains stationary, being wedged part into a circular hole in the platform; in the centre is a hole through which the spindles come from below; in this hole a brass socket is fixed to prevent the spindle from wearing, and the upper end of the spindle stands six or seven inches above the stone.

The upper surface of the stone being made perfectly flat and true, and laid quite level, it is punched full of small holes about a quarter of an inch deep, and three-quarters of an inch apart.

The upper stone or runner is prepared in the same manner, and exactly balanced on the top of the spindle, with its under surface fitting perfectly true to the upper surface of the nether stone. The hole in the centre of the upper stone is large, and has a cross fitted in it to form the centre socket which fits upon the spindle, so that between the arms of this cross the grain turned in can fall upon the nether stone round the centre.

The stones being thus prepared, and the mill in motion, the upper stone revolves with great velocity, while the nether stone is fixed; the lower end of the spindle, or pivot, on which the stone turns is planted upon a strong iron lever, which can be raised or lowered by a screw, and by this means the falls of the stones can be adjusted by the miller, either when the mill is in action or motionless, with the greatest possible facility.

The stones are covered by a hoop, or case, which entirely encloses them, leaving a space all round, between the stone and the hoop, of about two inches; on the top of the case is fixed the hopper, which is filled with paddy; it falls through a hole in the bottom of the hopper into a shoot, and is conveyed into the hole in the centre of the upper or running stone; it then falls through the arms of the cross before described upon the face of the nether stone round the centre. The

stones being in rapid motion, the paddy finds its way between the faces of the two stones, which are now supposed to be set at about the length of the grain apart; the grains are carried by the centrifugal force from the centre to the extremity of the stones, and thrown out in all directions into the case or hoop which surrounds the stones; in one side of this hoop is a hole, through which the rice in this state runs out.

The stones should be set, in the first instance, with great care, for if they are too near, the rice will be broken, and if too far apart, the paddy will get through without being touched; but, when set at the right distance, the husk will be completely taken off, and the rice not broken.

One pair of stones will husk from eight to ten bushels an hour with ease; the rice runs from the cases upon a fine sieve kept agitated by the mills; in passing over this, the dust and sand are separated; it then falls into the winnowing machine, which is to separate the husks from the rice; this is done by causing the husk and rice together, as they left the stones, to fall in a gentle stream through a current of air excited by a succession of fans revolving upon an axis, and driven by the engine in its passage through the current; the husk being much lighter than the rice is blown away, and the rice falls into a bin below.

There is one of these machines to each pair of stones, to separate the rice from the husk, in its passage from the stones to the bin; this part of the operation is most completely performed, and keeps pace with the stones.

The rice in this stage of the operation is more or less red, nothing more being done than the separation of the husk; after this, it is taken to the whitening machine, where the inside cuticle or red skin is detached.

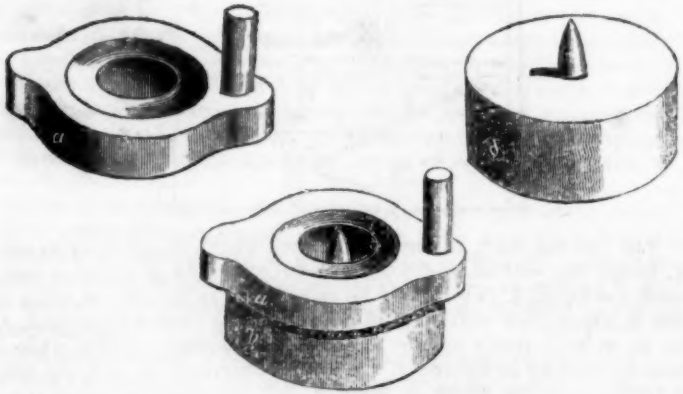
This machine consists of a stone of coarse grit fixed on a spindle like a grinding stone; the stone is inclosed in a box or case made nearly to fit, leaving a space all round of about an inch between the stone and the inside of the case; this case is made of plate iron, and punched full of small holes like a grater, with the rough side inwards; it is so contrived that the case may go round with the stone, or it may remain still while the stone is turning.

The rice is put in between the case and the stone, at a sliding door, or opening in the rim; the space is about two-thirds filled; the stone is then put in very rapid motion, making at least 250 revolutions a minute by a strap; the case is allowed to turn very slowly; this changes the position of the rice, and every grain in succession comes into contact with the stone, and, rubbing hard against each other, an accumulation of heat (which produces an enlargement of the grain, and consequently splits the red skin,) is produced, which serves to loosen the skin; and this, forming a red dust, finds its way out of the holes in the case, and leaves the rice perfectly white.

In the whole process there is little or no loss, for when the stones are well adjusted very few grains are broken, not more, perhaps, than 5 per cent. upon the whole, and those very partially.

*Reference to the engraving on the first page.*—*a* is a horizontal shaft driven by the steam engine, on which is fixed *b*, a bevil wheel, four feet in diameter; working into *c*, another bevil wheel of the same diameter, which works into four pinions on the spindles of the upper mill stones, two of which are shown at *e e*, each of two feet six inches in diameter; *f f*, spindles of the upper mill stones, having indented pinions, *g g*, near their tops, for the purpose of agitating sieves, which are not shown in the figure; *i i* are the upper mill stones; *k k*, the lower mill stones; *l l*, the hoppers; *m m*, the iron levers on which the spindles of the upper mill stones are planted, and which can be raised or lowered, to adjust the stones, by means of regulating screws, at *n n*; *o o* are screws to raise the pinions, *e e*, and cast them out of gear; *t* is a drum wheel, which works the winnowing machines by means of a strap, not shown. On the shaft, *a*, beyond the limits of our drawing, is placed another drum wheel, which drives, by means of bands, and a multiplying wheel, the two blanching machines before described.

For grinding *corrican* and other small grain, the Singalese use a small stone mill (*corrican galle*) consisting of two parts, *a* and *b*, which are put together as in the underneath figure, and the upper one is then turned by the hand, the grain finding its way between the cup and the central pivot. This simple machine, which (as Dr. Davy observes) has a near resemblance to the old Celtic quern, is, in fact, on the same *principle* as our modern and most celebrated mills, but it is only adapted for grinding small quantities of grain at a time. We, therefore, purpose to exhibit separately several very improved mills, in which the same principle is retained, but modified in such a manner as to produce vastly greater effects. In doing this,



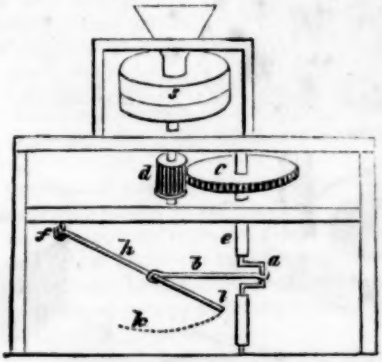
we are compelled to make an arbitrary selection from a great variety of other mills of considerable merit, and such only as strike our judgment to be best calculated to supply the wants of a country like Ceylon, and where the mechanical resources of the natives are, of

course, at present very much limited. For these reasons we shall now confine our attention to *stone* mills, the construction of *steel* mills being probably a branch of art to which the Singalese are at present not equal: besides which circumstance, it is much questioned by practical men whether steel mills are so well adapted for grinding raw grain as those of stone. Be this as it may, we shall in some of our future numbers take occasion to insert descriptions of the best steel hand mills, from time to time, and shall be ready to insert the communications of manufacturers thereupon.

We shall first describe what we will take leave to call

### THE ROWING MILL.

The most advantageous mode of applying human strength is similar to that of the ordinary manner of rowing a boat, wherein a man sits upon a low bench, and with his legs extended before him presses with his feet against an inclined board, whilst he pulls back a lever; because in this action the muscular strength of the individual is greatly assisted in the effort by the weight of his body as he throws it back. In Bockler's *Theatricum Machinarum*, there is a description of a mill, wherein this method of applying manual labour is employed, which will be understood by reference to the annexed engraving and accompanying explanation.




The vertical shaft, *e*, carries a toothed wheel, *c*; upon the crank, *a*, hangs one end of an iron bar, *b*, the other end of which is hung upon the lever, *h*, (which may be considered as the oar or scull of the boatman) one extremity of which is hung upon a fixed hook, *f*, so as to turn freely upon it as a centre of motion. Then, while a man by pulling at the end of the lever, *l*, moves it on to *k*, the bar, *b*, acting upon the crank, *a*, gives it and the wheel, *c*, half a revolution; and the wheel, *c*, simultaneously acting upon the small trundle, *d*, gives that and the upper mill stone, *s*, (which is fixed upon the shaft of the trundle) more than a revolution. A momentum is thus given to the mill stone, which it communicates to *d*, *c*, and

*a*, and the lever, *h*, is thus brought back from *k* to *l*. In like manner another pull at the lever, *h*, causes another rotation, and so on, at pleasure.

In this mill the nearer the end of the bar, *b*, upon the lever, *h*, is to the fixed hook, *f*, the easier will the man work the mill; and by having two or three hooks like that at *f*, fixed at convenient distances, the work of the mill may at any time be adapted to the strength, or the weight, of the individual, by shifting the lever, *h*, from one hook to another.

If the number of teeth in the wheel, *c*, be six times the number of cogs in the trundle, *d*, then the miller, by making ten pulls at the lever, *h*, in a minute, will give sixty revolutions to the upper mill stone in the same space of time.

Where a fall of water can be obtained it affords, with the aid of a little art, the cheapest and the most equable power for driving machinery; for this reason we shall now introduce a description of

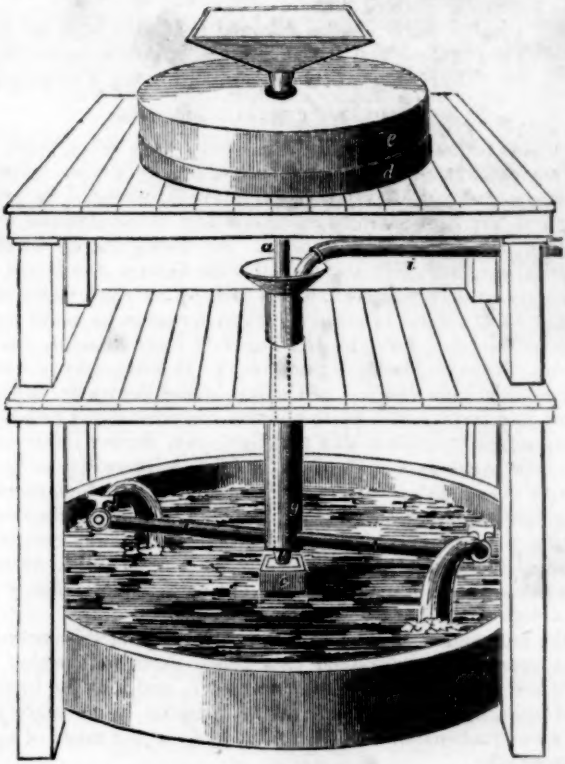
DR. BARKER'S CENTRIFUGAL MILL,

which was invented by the person whose name it bears, more than a century ago; it is, nevertheless, one of the most simple water mills ever constructed. It has been but rarely introduced in practice, although it has been warmly eulogised and recommended by most writers on the subject of hydraulics. Dr. Desaguliers, who published the first account of it, states that "Sir George Savill had a mill in Lincolnshire to grind corn, which took up so much water to work it, that it sunk his ponds visibly, for which reason he could not have constant work; but now, by Dr. Barker's improvement, the waste water only from Sir George's ponds keeps it constantly to work."—In the mountainous districts of Ceylon, where the water, in descending from one terrace of land to another, is successively employed for the purpose of irrigation, this machine may, during its descent, be most advantageously employed in husking, winnowing, or grinding any kind of grain, or in any other operation in which mechanical power might be useful. Hence we have considered Dr. Barker's Mill deserving a place here, being well assured that any ordinary mechanic in Ceylon is capable of readily making it, and at an expense far less than any other hydraulic power of equal efficacy can be constructed.

In the annexed drawing which we have made of this invention, it will of course be understood that those parts only which are in shadow are essential to the moving power, and that the incomplete framed building thrown over it has been added by us merely to assist the comprehension of the uninitiated as to the mode of applying the invention.

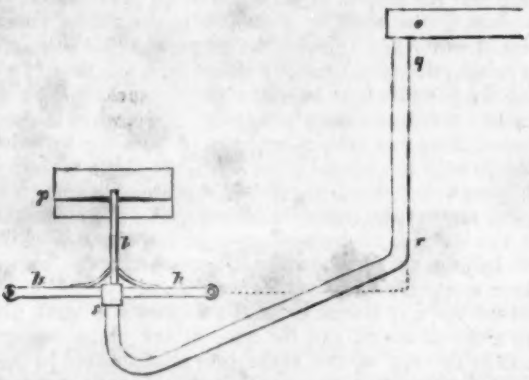
At *a b* is a vertical axis, moving on a pivot at *b*, which would be *best* made of steel, and to run in a brass step let into a block of stone as at *c;* this axis passes freely through the lower mill stone, *d*, and is then fixed to the upper stone, *e*. To the axis is also fixed the large vertical tube, *f g*, the upper part of which, *f*, is expanded into the shape of a funnel or basin, for receiving the water from the mill course or pipe, *i;* at the lower part, *g*, this tube has an open com-

munication with the hollow horizontal arms, *h h*, the extremities of which have each an opening near its extremity on one side, and so adjusted by stop-cocks for regulating the discharge that the vertical tube shall be always kept full of water, in order that the utmost force may be obtained, as a lateral pressure will be produced in all directions in the horizontal arms proportionate to the altitude of the column. Now this pressure being removed from the space forming the area of the aperture in a horizontal arm, by the water being permitted to issue through it, there will be a superabundant pressure on the other side of the arm in which there is no aperture, equal to the force with which the water would spout from the aperture were the machine fixed, and the water permitted to pass through it.




In the preceding form of Barker's Mill, the length of the axis must always exceed in height the elevation of the pipe, *i*, which in some cases might render the erection of such a machine difficult. To remove this difficulty, it was proposed by M. Mathon de la Cour, in Rozier's *Journal de Physique*, for August, 1775, to introduce the water from the mill course into the horizontal arms, *h h*, which are fixed to an upright spindle, *l*, as represented in the annexed diagram,

and without any revolving vertical tube, as in the previously described arrangement.




The water will now obviously issue from the apertures at the extremities of *h h*, in the same manner as if it had been introduced at the top of the tube in the former figure: hence, the spindle may be as short as we please. The practical difficulty which attends this form of the machine is to give the arms, *h h*, a motion round the mouth of the feeding pipe, which enters the arms, without any great friction or any considerable loss of water. In this form of the mill, *o* is the reservoir; *p*, the mill stones; *l*, the vertical axis; *q r s*, the feeding pipe, the mouth of which enters the horizontal arm at *s*.

In a machine of this kind, constructed at Bourg Argental, the tubular arms, *h h*, were each 46 inches long, and their inside diameter 3 inches; each of the orifices $1\frac{1}{8}$ inch diameter; the height of the working head was 21 feet above the points of discharge. This, though a great fall, is evidently a very small consumption of water, since it was all supplied by a 2-inch pipe, and when the machine was not loaded, and had but *one* orifice open, it made 115 turns in a minute. Thus a prodigious centrifugal force is produced in the arms, and a corresponding velocity, far exceeding that of a simple fall of water, with a pressure of 21 feet head. The machine, when empty, weighed 80 pounds, and it was half supported by the upward pressure of the water.

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*On the blowing of Air into Furnaces by a Fall of Water. By the late celebrated* William Lewis, M. D.

[Continued from p. 382. Vol. V.]

EXPERIMENTS OF AIR PASSING DOWN THROUGH PIPES WITH FALLING WATER.

*Water running through a Crane.*

In the running of water through a syphon, or common crane, when the sucking-pipe on the longer leg of the crane was stopped up, the

water, as it issued from the extremity, filled the bore; on opening the sucking-pipe, the column of water appeared less than the bore.

Judging that the motion of the water must be retarded in this last circumstance, I measured, by a pendulum, the times in which equal quantities of water ran through the crane in both cases, and found, in many trials, that the quantity which took the time of a hundred swings of the pendulum to run in when the sucking-pipe was open, ran in ninety-three, and sometimes ninety-two, when it was stopped.

As these differences seemed to proceed from air introduced into the water through the lateral pipe, I tried to make the air sensible, by raising the vessel which received the water from the crane, and keeping the nose of the crane immersed in it. As often as the sucking-pipe was opened, air-bubbles arose in the water of the receiver, and fresh bubbles succeeded while it continued open; but so long as it was kept stopped no air bubbles were seen.

To collect the air, a cask without a bottom was sunk nine or ten inches in a tub of water, and the nose of the crane inserted into a hole made in the top of the cask: into another hole in the top was fitted a small pipe for giving vent to the air, and within the cask was fixed an inverted mortar, for the stream to fall on. So long as water was kept running through the crane, with the sucking-pipe open, a sensible blast issued from the blowing-pipe of the cask, and a burning coal exposed to it was excited in the same manner as by a common bellows; the sucking-pipe being stopped, no blast was perceived, nor was any motion produced in the flame of a candle applied to the orifice.

It appears, therefore, that water, running through an upright pipe, and filling its bore, admits air to enter through a lateral pipe; that, after this admission, the width of the column of water contracts, the introduced air occupying part of the capacity of the pipe, and that this air passes down on the outside of the water, or in a separate column, not intermixed with it, so as to render it frothy.

*Water descending through an oblique pipe, with lateral apertures.*

I varied the foregoing experiment, by taking, instead of the crane, a leaden pipe, about ten feet long and three quarters of an inch bore. Several holes were made, at intervals, in the length of the pipe, and small tubes fixed into them, like the sucking-pipe of the crane. The pipe being laid aslope, its upper end was turned up perpendicularly, and a funnel fitted to it, which was supplied with water by a cock in the bottom of the reservoir: the other end of the pipe, which the water issued from, was inserted into the air-vessel used in the preceding experiment.

The lateral tubes being stopped, and the cock so turned as to let the water run fast enough to keep the funnel always full, no air issued from the blowing-pipe. On opening the tubes, a considerable blast was perceived; the water passed slower through the pipe, so that the same stream made the funnel run over; and on pulling out some of the tubes, and looking in through the holes, the column of water was very visibly less than the bore of the pipe. The tubes

being stopped again, the blast ceased, and the stream did no more than keep the funnel full.

A small variation in the circumstances of this experiment made a very material difference in the effect. The supply of water having been diminished, so as to rise only a little way above the throat of the funnel, a pretty strong blast issued from the blowing-pipe, though all the lateral holes were closely stopped, and when the tubes were open, instead of air passing in by them, a blast passed out from them, the air-vessel in this case yielding none; so that here the air must have been introduced at the top, and passed down the funnel, and afterwards escaped where it first found a vent. To be further satisfied in this point, I repeated the experiment, with a somewhat different apparatus, in the following manner.

*Water falling through a Funnel.*

The glass receiver of an air pump, about two feet high, open at both ends, had its lower end immersed about seven inches, in a vessel of water, and supported at a proper distance above the bottom for the free passage of the water under the edges of it.—A brass plate being pressed close on the top, with a leather between, a glass funnel about twelve inches deep, and above half an inch in diameter in the throat, was fixed into a hole in the plate; and into another hole was fitted a small blowing-pipe.

A stopper being introduced into the funnel, till the water it was filled with had become perfectly quiet, and then cautiously removed, the water ran in a stream, which falling into that in the receiver, produced air-bubbles, but no blast issued from the pipe; and when the pipe was stopped, the water in the reservoir did not sink lower than the level of that in the outer vessel; whereas, if any air had entered with the water, and been compressed in the receiver, it must have forced a proportional quantity of the water out below.

The funnel was then supplied from a pipe, by which the water was made to dash against the side of it. By this means, the fluid received a spiral motion, and whirling round the funnel, left a large vacuity in the middle, reaching down, sometimes, to the funnel's throat. The stream as it ran through, was also twisted; a sensible blast issued from the air-pipe; when the pipe* was stopped, the water in the receiver was forced lower and lower, and was soon driven entirely out, abundance of air bubbles following it into the water in the outer vessel.

When the funnel was kept entirely full, though the stream was directed against its side, there were little marks of any air being carried down. And when the funnel was nearly empty, the effects were also inconsiderable, the vacuity in the middle of the spiral circumvolutions of the water, seeming to reach to the bottom, so as to suffer the air to escape upwards, through the hollow column of water.

*Water falling from a considerable height into a Funnel with a pipe.*

A leaden pipe, six feet high and an inch and a half in diameter, was inserted into an air-vessel, with the water-gauge already described. Into the top of the pipe was fixed a tin funnel, whose

* Exhaust air pipe

throat fitted close to it; and into the funnel a stream of water let fall, from a reservoir five feet above, in quantity sufficient to keep the funnel running over. This apparatus represents Marriotte's blowing machine, before described.

The water divided by the fall, pushed down abundance of air with it: a strong blast issued from the blowing-pipe, and the gauge rose high. On raising up the funnel a little, the stream that issued from it appeared all frothy: as often as the funnel was lifted up, the gauge sunk, the air which had been driven in by the dash of water escaping between the funnel and pipe; on letting down the funnel close, the gauge immediately rose again.

Instead of a fall of five feet, a stream was directed into the funnel, from only about half that height. The gauge still rose considerably, though not so high as before.

It is observable, that in the circumstances of these experiments, a whirling motion communicated to the water in the funnel, impeded the carrying down of air, the gauge always sinking on the water receiving such a motion.—Whereas, in those of the preceding article, it seemed to be by the whirling of the water, that the air was pushed down.

It appears, therefore, that there are two ways, of making air pass down with water through a funnel; one, by directing the stream against the side of the funnel, the other, by letting it fall from a great height: that in the one case the air enters between the spiral circumvolutions, which the water forms in the funnel; and, in the other, between the drops, into which a considerable part of it is reduced by the fall: that we cannot avail ourselves of both ways at once, the one impeding the effect of the other; and, that in either case, the air-holes under the throat, so necessary in other machines, can have no place, as they give a vent to the air brought down from above.

*Water falling from a funnel through a pipe with air-holes.*

The six-feet pipe, used in the foregoing experiment, continuing fitted into the air-vessel, its upper orifice was widened that the small end of a funnel-shaped copper pipe, of the same bore with the preceding funnel, might hang freely in it, without touching the sides. The funnel pipe reached up to the reservoir, and was kept always full; that the water might receive little or no air, but at the vacuity, between the nose of the funnel and the leaden pipe.

In this situation, the quantity of air was much less than in the preceding; the water fell through the funnel in a stream not at all frothy, and the gauge rose but a little way. I widened the aperture of the leaden pipe to let in more air, but still the gauge continued low.

Into the orifice of the funnel I inserted a smaller pipe, whose diameter was one inch, and whose area was of consequence less than half of that of the leaden pipe. The blast was now strong, and the gauge rose higher than when the water fell from an equal height, into the low funnel of the foregoing article. I tried funnels considerably smaller, and found the gauge still to rise high: but at last, with one

of a quarter of an inch in diameter, it did not rise at all, and no blast could be perceived.

One of the funnels which answered best, being properly fixed, with two or three inches of its neck hanging free within the wider pipe; I made several variations in the manner of admitting the water and air, with a view to compare the effects of different ways of admission. The funnel being full, and gently supplied, so as to keep the water in it as steady as possible, the height of the gauge was marked: on giving a circular motion to the water, or letting it fall from a height, the gauge always sunk, even a slight whirl or dash sensibly affecting its height. The space between the nose of the funnel and the pipe was stopped, so that no air could enter but at the top: the funnel being now full, and the water quiet, the gauge scarcely rose at all; on whirling the water, it rose considerably, and when the water fell from a height, it rose further, though not so high as the standard mark.

It appears, therefore, that there are two general methods in which water may be made to carry down air; one in which it receives the air at the top, and the other through lateral apertures; and the circumstances which contribute to the effect in the one case, impede it in the other: that water, being at rest in a funnel, and then suffered to run through, carries little or no air with it: that when made to whirl round in the funnel, it carries a considerable quantity; and that when it falls from a height, so as to be in part dashed into drops, it pushes down considerably more; that running through a pipe with lateral apertures, perpendicular or obliquely, it receives air through the apertures, even when its motion is slow; that when the pipe is of equal bore throughout, the quantity of air thus received is not great; but that, when the pipe is contracted to a certain degree, in the part where the apertures are, the quantity of air is greater than that introduced through a funnel without air-holes: that air, brought down from the top of the pipe or funnel, prevents the introduction of fresh air through the lateral holes; which, in this case, instead of receiving more air, discharge that already received.

Finding that the two general methods by which air is made to pass down with a stream of water, could not be united in one machine, and that the pipe and funnel, with apertures for the entrance of air, about or under the throat of the funnel, have the greatest effect, I proceeded to examine the most proper form and disposition of these.

### EXPERIMENTS AND OBSERVATIONS FOR REGULATING THE STRUCTURE OF THE FUNNEL AND PIPE.

#### *Experiments with funnels and pipes of different heights.*

The water, as already observed, passing through the narrow throat of the funnel, is afterwards enlarged into a jet, which fills the bore of a wider pipe. The quantity of air introduced appears to depend upon the degree of this enlargement, and on the quantity of water that runs through in a given time.

The greater the height of water above the narrow throat, the

greater velocity will the jet receive, and the more it will be disposed to spread and be enlarged. The length of the pipe does not appear to be of so much importance; it should seem sufficient, if the pipe is of such length, that the pressure of the water in it may be able to resist the compressed air in this vessel; and that after part of its power has been spent in overcoming that force, it may still have velocity enough left to run down as fast as it can be supplied from the funnel. In order to arrive at some determinable proportions, the following trials were made:

A leaden pipe, seven feet high, and an inch and a half in diameter, being fitted into an air-vessel, as in the foregoing experiments, funnel-shaped pipes, of different heights, were supported over it, so as that the small end of the funnel might hang freely in the orifice of the leaden pipe, and leave space enough for the entrance of air all round. For the greater security of the throat being of the same area in all the funnels, one and the same copper pipe served as a throat for them all: the funnels being formed, by inserting this pipe into larger tapering ones, of different heights. The funnels were always kept full, and the water conveyed into them as gently as possible, so as to produce no dashing or whirling motion.

A funnel of one foot high had very little effect: the rising of the gauge in the air-vessel was inconsiderable, and the stream of air from the blowing-pipe was but just to be felt: on opening some holes made in the leaden pipe, under the throat of the funnel, the jet of water appeared not to spread, but was rather contracted, and did not fill the bore. With funnels of two or three feet the gauge rose more, and the jet spread, though it did not appear to fill the pipe, till it had reached about half way down to the bottom. Funnels about five and six feet high, produced a strong blast, and kept the gauge high, the jet filling the pipe, before it had fallen a foot below the throat of the funnel.

On many repetitions and variations of these experiments, I have not observed that the jet spread sufficiently, with less than a fall of five feet. With a fall of sixty-four inches, the gauge rose more than five times as much as with one of sixteen inches; though the quantity of water which ran in the first case, was only double to that in the latter one; viz., as the square roots of 64 and 16: from whence it is plain that the above differences do not depend entirely on the different quantities of water which run through the funnels of different heights; but, in great part, on its different velocity. Some other experiments seemed to confirm this point: for, having used short funnels, so much wider than the high ones, that the quantity of water discharged by the former, was equal to, or greater than that by the latter; the short funnels never produced so strong a blast, or raised the gauge so far as the others.

Being satisfied of the advantage of having the funnel of a very considerable height, I, in like manner, varied the length of the pipe. Having made a mark at the part where the gauge rose to, when the funnel was five feet long, and the pipe seven, I added to the pipe about a foot more; the gauge scarcely rose any further. A foot

being cut off from it, the gauge fell a little: two feet being cut off, it fell considerably; and the retrenchment of another foot made the machine of little effect, the gauge sinking almost to the bottom, and the blowing-pipe yielding but a weak current of air. The pipe, reduced thus to four feet, was tried with a funnel of near eight feet long; in this case there was no blast at all. But, with funnels, less than its own height, as of two and three feet, it still raised the gauge considerably.

It appears from these experiments, that in most of these machines described in the preceding section, the lengths of the funnels and pipes are greatly disproportioned to one another; and consequently the water applied to disadvantage. Those of Dauphiny in France are particularly faulty in this respect, the funnels being scarcely three feet high, and the pipe twenty-five or twenty-six; with so small a height of water above the choak, I have never been able to make the jet spread near to such a degree, as it is said in the machines of Dauphiny, without particular contrivances for that purpose, which will be mentioned in the sequel of this paper.

The Foix machine agrees the best with my experiments; but, as the funnels of the others are undoubtedly much too low, that of this seems to be rather too high. The effect seems to be the greatest when the funnel is about two-thirds the length of the pipe.

*Experiments of the Disposition of the Air-holes.*

In the foregoing experiments, the simplest and most obvious way of admitting air was chosen, by leaving a space between the funnel and pipe.

The air-pipes of the machines of Foix and Languedoc answer the same end, carrying in the air above the surface of the jet of water. As the other machines have the air-holes under the jet, I tried what variations would result from this circumstance, and from making the apparatus of different depths, under the throat of the funnel.

Into a pipe of six feet in length was fitted a funnel of four feet; and six inches below the orifice of the funnel four holes were bored round the pipe, sloping down from without, inwards: eight inches lower down, I made another row of holes; and at like distances under these, a third and a fourth. To each hole was fitted a stopper, which exactly closed it.

All the holes being stopped, the funnel was first hung free in the pipe, as in the former trials, and the height to which the water rose in the gauge was marked. The funnel being then let down into the pipe, so as exactly to close it, the upper air-holes were opened; the gauge did not now rise so high as before. The upper air-holes being stopped and the second row opened, the gauge continued at its last height. With the third row open, it rose rather higher than the first mark; and with the fourth, it fell the lowest of all.

The several entrances for the air were then opened by two and two. With the space between the funnel and pipe, and the upper air-holes open, the gauge did not rise so high as with the space only; and with the upper, and second row of holes, it continued at the same height.—With the second and third it rose considerably further,

though not up to the first mark; and with the third and fourth it fell a little below the preceding height. In all these cases, where two rows of holes were open, the water manifestly did not fill the bore of the pipe at the upper holes; but spread so as completely to fill it, by the time it had reached the lower ones: at which last, part of the water spirted out, and carried some of the air with it.

In another pipe of the same size, I made two sets of air holes, three inches apart, and the uppermost of them twelve inches from the orifice of the funnel. With the uppermost row open, and with both rows open, the gauge rose almost equally, being only a little lower in the latter circumstance than in the former; but with only the lower row open, it sunk about one half. These being all stopped, and another set bored opposite to the orifice of the funnel, the gauge rose as high as in the first case.

These experiments, and several others I have made on the same subject, are not so conclusive as I should wish. They seem to show that it is more eligible to have the entrances for the air in one horizontal plane, than in two planes above one another; and either above or at some distance below the jet, than immediately under it: that they ought to be of greater magnitude than in some of the machines described in the first section, particularly in that of Lead-hills, whose air-holes, taken altogether, are not of half the area of the space in the pipe which the air has to fill. They ought, at least, to be of an equal, or rather of a double extent, that the air may enter the more freely.

[TO BE CONTINUED.]

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*Analysis of Tutenag, or the White Copper of China. By* ANDREW FYFE, M. D., *Lecturer on Chemistry, Edinburgh, &c.*

VERY different statements have been given of the composition and origin of tutenag, used by the Chinese in the formation of many of their metallic utensils.

According to Keir, it is a white alloy of copper, zinc, and iron, which is very hard and tough, but at the same time malleable, and taking a fine polish. An inferior sort of it, according to the same author, is more of the colour of brass.

De Guigne, on the contrary, states, that its properties, especially that of imparting to copper a white colour, and rendering it less liable to acquire verdigris on its surface, prove that it does not contain zinc. According to him it is an alloy of iron, lead, and bismuth.

Engestroem, in the Stockholm Memoirs, states, that the *Pak-Fong*, or white copper of China, is composed of copper, nickel, and zinc, the last of which amounts to seven-sixteenths of the whole, and the proportions of the two first are to each other as 5 to 7.

Dr. Howison of Lanarkshire was so fortunate, when in China, as to procure a basin and ewer of Chinese or white copper, a part of which he sent me for analysis.

From the experiments I have performed on it, I find the composition to be different from what is stated by the above-named chemists; its component parts being copper, zinc, nickel, and iron; the last of which, however, is but small in quantity.

The basin in the possession of Dr. Howison is of a whitish colour, approaching to that of silver; and is very sonorous. When held in one hand, and struck with the fingers of the other, the sound is distinctly heard at the distance of an English mile: it is also highly polished, and does not seem to be easily tarnished. The piece that was sent me I found was malleable at a natural temperature, and at a red heat; but when heated to whiteness, it was quite brittle, breaking with the slightest blow of a hammer. By great caution, it was rolled into thin plates, and was drawn into wire of about the thickness of a fine needle. When fused in contact with the atmospheric air, it oxidated, and burned with a whitish flame, in the same way as zinc does. Its specific gravity at 50° was 8.432.

Five grains of it were subjected to analysis, with the view of ascertaining the proportion of its ingredients: the result was,

| | | |
|---|---|---|
| Copper - - | 2.02 or in the 100 parts, | 40.4 |
| Zinc - - | 1.27 | 25.4 |
| Nickel - - | 1.58 | 31.6 |
| Iron - - | 0.13 | 2.6 |
| | 5.00 | 100.00 |

The method which is practised in preparing white copper is not known in this country; though it seems to be the general opinion that it is procured by the reduction of an ore, containing the ingredients of which it is composed. In a letter I received from Dr. Howison, he mentions, that Dr. Dinwiddie, who accompanied Lord Macartney to China, showed him, when at Calcutta, several specimens of the ore from which he was told the white copper was procured, and which he obtained at Pekin. The basin in the possession of Dr. Howison cost in China about one-fourth of its weight in silver; and the exportation of utensils of this alloy is prohibited. These circumstances also render probable the opinion that the white copper is obtained by the reduction of a metallic ore; for in China labour is cheap; and the metals composing it are said to be found in great abundance.

[*Edin. Phil. Journal.*

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*On Various Processes employed in Jewellery. By* Thomas Gill, Esq.

The jewellers are in the habit of performing many operations, in the formation of their delicate and beautiful works, in a manner which is highly deserving of adoption in other branches of manufacture. It is with this view that we have determined to lay before our readers some of the more important of these processes; and, first,

*On soldering, in jewellery.*

*In soldering with silver solder*, the thinly laminated solder is scraped perfectly clean, and then cut with hand-shears into very small square bits, by first dividing the sheet into narrow slips lengthwise, and then cutting them again across. The lump of borax, which is employed as a flux, is rubbed with water, to a thick consistence, upon a flat piece of black slate, scored all over crosswise, to cause it to act upon, or abrade, the lump of borax the more readily. When the pieces to be joined are ready for soldering, with a small camels'-hair pencil, having a slender ivory handle, flattened at its point, they take up some of the prepared borax, and apply it by means of the pencil, to the parts to be united; they next mix, upon the thumb-nail of the left hand, some of the small square bits, or pellets, of solder, taken up on the hair-pencil, with borax, so as to cover them perfectly therewith: these pellets are then carefully applied, by the help of the point of the ivory handle, to the parts to be soldered: and they are then laid upon charcoal ashes, contained in a small crucible, and are submitted to the action of the flame of a lamp, urged by the blow-pipe; carefully, however, avoiding to heat them too suddenly, or before the borax has ceased bubbling, during the driving off its water of crystallization (which, however, in this mode of employing it, is considerably less than in the ordinary practice,) lest the pellets should be displaced. When the solder has flowed, they very carefully avoid heating the article more, lest it might melt.

In case they wish to prevent the solder from spreading over the surrounding parts, they previously coat them with a layer of Indian ink, applied with another camels'-hair pencil.

*In the soldering of filagree-work*, the process is different. The gold or silver solders are previously reduced, by filing, to a state of minute division, and are then put into proper small cylindrical metal-boxes, with lids closely fitted to them, and having near their bottoms slender pipes, to allow a little only of the powdered solder to escape at a time, by the action of the finger-nail, rubbed upon a serrated piece of metal, affixed upon the pipe.

The articles to be soldered require to be treated according to their nature and forms. If, for instance, a number of similar twisted wire rings are to be united in a flat circular form, they are to be laid upon a piece of charcoal, sawn and rubbed flat, and are arranged and kept in the required form, by the application of a thick solution of gum-tragacanth, brushed over them and the surface of the charcoal: they are then either laid by, to afford the gum time to dry leisurely; or, if haste prevents that, they must be exposed to a very gentle heat. When dry, the thick mixture of borax before mentioned, must be brushed over them, and the solder be sprinkled upon them in the manner just described: they are then exposed to the action of the flame of the lamp, whilst lying upon the surface of the charcoal;—great care and address, however, is requisite in the management of this very delicate operation, as the least excess of heat would inevitably fuse the whole into a solid mass.

When such an arrangement has been thus formed, and other parts

are to be soldered to it, a solder of a more fusible nature must be employed; and the parts are either to be arranged upon charcoal, in the manner above described, or they may be held and supported upon the branched extremities of a congeries of jewellers' twisted fine iron binding-wire, formed as follows:—Several similar lengths of wire are first twisted together, three at a time, leaving a portion of each untwisted: these are again united together at one end, in three or more sets of three each, leaving their exterior ends at liberty, and, lastly, these combined sets all are united by twisting them together. The mass forms an exceedingly convenient support for the infinite variety of different articles of jewellery, which require to be soldered together; and their union is effected, as before described, by the application of the borax and solder, and exposure to the flame of the lamp.

*On the boil, for gold work.*

It is a very curious circumstance, that the best workmen in this branch of jewellery have at this day no other menstruum for giving the last high finish in colour to their beautiful articles than the employment of the compound salts of alum, nitre, and common salt, wherewith to form a sort of aqua-regia, or nitro-muriatic acid; instead of employing the nitro-muriatic acid itself:—such, however, is the fact.

They put into a crucible one part, by weight, of alum (sulphate of alumine,) two parts of nitre (nitrate of potash,) and one part of common salt (muriate of soda,) with a very little water; and make it boil over the fire in the forge-hearth. When the salts are dissolved, chiefly in their own water of crystallization, the articles, previously strung upon a platina wire hooked together at its ends, are put into the boil, as it is termed, and frequently taken out from time to time, and washed in water, to see when the proper effect is produced; which is longest in taking place in those parts which are united by soldering.

In this mode, the copper, or silver, which entered into alloy with the gold forming the articles, are dissolved; and the surface of the articles appears of a true gold colour only.

This process, or one differing from it only in the proportions of the three salts, has long since been published in Smith's "*Laboratory, or School of Arts*," as a solvent for gold; equal parts of each salt being employed: and in this way the Editor succeeded in readily dissolving leaf-gold; the salts becoming tinged of a deep yellow colour, and the fumes of the nitro-muriatic acid extricated most copiously. He also succeeded, by the employment of French brandy, in taking up the gold from its solution, leaving the salts perfectly white; and thus forming, as it were, an ethereal solution of gold. It is, however, most certainly an improvement, to double the quantity of the nitre.

*To recover the gold from the washings of the boil.*

Strange as it may appear, yet it is a fact, that, till very lately, the jewellers constantly threw away the water into which they had dipped

the articles taken out of the boil, without being at all aware of the quantity of gold they also threw away with it! Latterly, however, a person possessed of more chemical knowledge, has made a considerable benefit by instructing the jewellers, at the price of five guineas each, in the method of recovering that gold which heretofore they had so very thoughtlessly wasted. His process is as follows:

The water is put into a large earthenware pan, kept constantly covered, and a solution of copperas (sulphate of iron) is added to it: the gold soon appears, in the form of an impalpable powder; and, when a sufficient quantity is separated (in a week's time, for instance,) and when no turbidness is produced on adding more of the solution of copperas, the water is poured off, and the sediment put by to dry; the sediment being preserved from time to time, until a sufficient quantity is collected to be fused in a crucible, with the addition of nitre to oxidate the iron. The gold is thus obtained in a state of purity.

*On forming the gold beads used in filagree-work, &c.*

These are made by boring shallow conical holes with a toothed rimer, all over the surface of a piece of flat charcoal; and, according to the intended size of the beads, putting into each hole, two, three, or more rings of gold wire, formed by wrapping the wire around a cylinder of about a quarter of an inch in diameter, and then cutting the helical coil of wire into single rings, each containing a similar quantity of gold, which is the object of coiling and cutting the wire into rings. These being submitted to the action of the flame of the lamp, urged by the blow-pipe, quickly fuse, and unite together into small globular beads.

*On melting gold and silver on charcoal, and casting them into shape.*

The jewellers avail themselves of the exceedingly slow conducting power of charcoal for heat, to melt a considerable quantity of gold or silver occasionally, without the employment of a crucible, or the use of a forge-hearth or wind-furnace. To effect this, they saw asunder, lengthways, a cylindrical piece of sound charcoal, and rub flat both faces. The charcoal ought to be at least two inches in diameter, and seven or eight inches long. Near the end of one of the pieces, they excavate a hemispherical cavity, large enough to hold the scraps of gold or silver which they intend to melt together with a sufficient quantity of borax to flux them. Between the two prepared surfaces of the charcoal, a flat piece of copper, or other proper metal, is then put, of a thickness equal to that of the mass to be cast, and having a cavity made in the end of it, of the shape to be given to the gold to be cast, and opening at the end, outwardly: this is smoked all over, by being held over the flame of a lamp, previous to its being placed between the two pieces of charcoal; and the whole is bound firmly together with iron binding-wire.—It should be observed, however, that, previously to placing the metal mould between the pieces of charcoal, a slit or channel must be cut, leading from the hemispherical cavity in the charcoal to the mouth of the mould.

When all is ready, the flame of the lamp is directed, by means of the blow-pipe, upon the gold or silver in the cavity; and the heat continued until the metal is melted; when, by inclining the charcoal, it flows directly into the mould.

A variety of moulds are of course provided; and thus small quantities of gold or silver are cast into various forms, with great convenience.

*Of the Jewellers' Lamp.*

This is of a very simple and convenient form, being made on the principle of the bird-fountain; that is, having an air-tight reservoir at its back, to hold a supply of oil, and a cup to receive it; and always containing an equal depth of oil, which is regulated by the situation of the hole made at the bottom of the reservoir, where the oil enters the cup. In the front of the cup, a spout is fixed to receive the cotton-wick of the lamp, which is of the thickness of a finger. The front of the spout forms a tube; but the back of it is open at the top, for the purpose of pushing the wick outwards, by means of the beak of the blow pipe, when the lamp is to be used; or of retracting it nearly within the end of the spout, to keep it merely alight during the time it is not in use, and thus avoiding a useless waste of oil. This lamp is supported upon a stand or foot, of a convenient height for use.

[*Tech. Repository.*

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## *On the Affinage (or Refining) of Gold and Silver, in France.**

In the arts, the name of *affinage* (or refining) is given to the purifying of different substances; but this expression is more especially employed to designate the purification of gold and silver.

In many of the employments of gold and silver, it is necessary that these two metals should be in a state of absolute purity, because it is only then that they possess the malleability requisite for the purposes they are designed for. The leaves, so light and thin, which the gold-beater obtains by hammering, are the product of a metal entirely free from copper; the smallest portions of alloy communicates such a hardness to these two metals, that it becomes impossible to give them that extreme degree of tenuity which is necessary in many of the arts. Gold and silver do not waste in this process, because they possess nearly the same degree of malleability; but the great difference which exists in their respective values, renders them not capable of being sold in commerce, until after they are completely separated the one from the other, and which is the principal aim of the refiner.

If the alloy which is proposed to be refined contains only gold, with silver, or copper, it becomes useless to submit it to a preliminary purification; but as it almost constantly happens that the fused masses contain tin, and often even lead, acquired in the operation of refining,

* Translated from the *Dictionnaire Technologique* for the Technical Repository.

we are obliged previously to free these matters from the least remains of all the foreign metals, leaving the two only to which we give the title of fine, so that we have only to perform the subsequent operation of separating the gold from the silver. This first purification is termed *la poussée*, because its effect is to *push* the refining as far as possible. I will now describe in what manner it is performed. We commence by ascertaining, by means of the process known by the name of *assaying*, the real title under which the matters submitted to the operation have to be considered: if the gold predominates sufficiently to form more than a fourth part of the alloy, they determine the proportion of silver necessary to be added to perform the process of *quartation*. It is indispensably necessary thus to increase the quantity of silver; as we have always observed, that when the alloy contains a less portion, it is in some way defended from the action of the acids by the gold; whereas when the alloy is formed of at least three parts of silver to one of gold, the acid easily penetrates the whole substance of the mass, and extracts even the smallest portions of silver. These proportions being well determined, we place a good earthen crucible in the midst of charcoal in a wind-furnace, and give it a good red heat; we then put into the crucible as much of the mass as, on being fused, will nearly half fill it;—we generally fuse from 15 to 20 marcs at once. As the metal is ready to fuse, we add half a pound of nitrate of pot-ash; we then close the crucible, and cover it with charcoal. At this time the heat must not only be sufficiently intense to fuse the alloy, but also to effect the decomposition of the salt-petre, and the oxidation of the baser metals; it produces a considerable ebullition, sufficient to effect the disengagement of the gas which is then formed; and it is on that account that the crucible should only be half filled. When the matter is perfectly fused, which is known by stirring it with an iron rod, we augment the fire; and the fusion having become tranquil, and the scoriæ entirely separated, the crucible is withdrawn from the furnace, and left to cool: it is afterwards broken, and we find a homogeneous button, which we detach from the scoriæ with which it is covered. These scoriæ contain much caustic potash, and are powerfully affected by the humidity of the atmosphere. They contain also the oxides of copper and tin, and sometimes of lead and iron; we also find in them a small quantity of an alloy of gold mixed with silver: all these scoriæ are put aside; and when a large quantity is collected, they are fused with charcoal powder, and the alloy obtained is submitted to *cupellation*.

The mass of gold and silver which is produced by the *poussée*, is fused anew, and reduced into grains by being poured into a vessel of water, at the bottom of which a copper vessel is placed. We thus divide the metal, to cause it to present a greater surface, and to facilitate its solution; and we therefore endeavour to obtain it in the smallest grains and thinnest leaves possible, which is readily done by pouring the metal into the water, from a certain height above it, taking care that the thread of fused metal should be as small, and as much continued as possible. We raise the basin which contains the

grains, decant the water from them, and dry them over the fire. We finally distribute these grains into glass matrasses with broad bottoms, earthen bottles, or vessels of platina, which we place in a gallery furnace, and pour into each vessel two or three parts of nitric acid, at 30° or 35°: we slightly heat them, to facilitate the action of the acid; the acid is soon decomposed, nitrous gas is disengaged, and the solution is effected. When the effervescence has ceased, we decant the fluid, and pour on a small quantity of fresh acid: it is again heated almost to ebullition; we decant afresh, and then add a third and last portion of acid, but more concentrated, and which is also made to boil. The silver will then be completely dissolved, and the gold will remain at the bottoms of the vessels in the form of powder, or in small masses of a yellowish brown colour. We wash the gold well, and re-unite it in crucibles, where it is fused, adding to it a little nitre: this is what is termed gold of *depart*. To obtain the silver contained in these solutions, we pour them into large earthen vessels, and plunge into them plates of copper: this metal is dissolved in the acid, and the silver deposited in the form of crystallized masses, more or less compact, according to the greater or lesser degree of concentration of the acid. To judge when the operation is entirely terminated, we pour some drops of a solution of marine-salt, in a small proportion to that of the fluid. If it remains limpid, all the silver is separated: lastly, this powder is washed, until the water it is washed in is no longer coloured blue by the volatile alkali. We fuse the silver with a mixture of six parts of saltpetre and one part of borax. When the matter is in tranquil fusion, it is poured into an ingot mould, which had previously been greased: when the ingot is cold, it is plunged into water, to separate the saline particles which adhere to it.

The silver which is thus obtained, when the operation is conducted with care, serves anew for *quartation;* but it is not in the most pure state; it contains some atoms of copper, from which it is readily freed by *cupellation.*

The precipitation of the silver by the copper is effected in a longer or shorter time, which is regulated by the quantity of fluid on which we operate, its degree of concentration, the thinness of the leaves of copper, and the temperature of the atmosphere. When we operate upon considerable quantities, we may withdraw a portion of the solution of copper; and as it contains a large quantity of water, we concentrate it in an open vessel, such as a copper basin, or, which is better, a vessel of platina. The concentrated fluid is finally put into earthen cucurbits furnished with heads, and placed in a gallery furnace; we adapt their receivers, lute the joints with clay, heat them, and distil to dryness. M. Vauquelin advises us to separate the acid which is obtained into two portions: the first which is collected serves for the process of the *depart;* the second part remaining in the retort. This *aqua fortis* is very pure, and does not need to be purified by precipitation, like that which is ordinarily sold. I believe, notwithstanding, that it contains nitrous gas, which renders it improper for the use of the assayer. We find remaining in the cucurbits a brown

powder, which is the oxide of copper: to reduce it, we mix it with an equal part of black flux, and fuse it in a crucible.

Many able metallurgists have thought that the gold of the *depart* retains a little silver; and M. Lesage had shown that this gold, dissolved in the nitro-muriatic acid, threw down a precipitate, at the end of several hours, consisting of a small quantity of muriate of silver. He also thought that the silver of the *depart* retained a small portion of gold. These ideas engaged the attention of M. Dizé, then refiner in the mint, and caused him to seek for other processes which might furnish more exact results; and, after numerous experiments, he found that the sulphuric acid offered great advantages in this respect, because that by using it he discovered in the silver minute quantities of gold, by the means which we shall now describe. The process used by M. Dizé is brought into use, and actually employed in the large, in many establishments at Paris. When new masses of silver are brought to these refineries, they extract from them a portion of gold, which would otherwise be entirely lost. They estimate this portion at a thousandth part of the total weight of the silver, which is nearly equal in value to thirty-five thousand francs, for a thousand kilogrammes of silver. If we calculate how many thousand kilogrammes of silver are annually employed in money, commerce, and the arts, we shall be convinced of the great quantity of gold which is thrown into circulation at a total loss. The process, as now performed, consists of five different operations, which we shall now describe.

1st Operation.—Upon several furnaces, of one foot each in diameter, are placed vessels of platina, of an oval form, each of which receives about 3 kilogrammes of granulated silver, on which is poured 6 kilogrammes of concentrated sulphuric acid. Each vessel is covered by a cone of platina, having at top an opening of about 4 lines in diameter, to allow the vapours to escape. They adapt to each orifice a pipe of platina, or a tube of glass, which conducts these vapours to a condensing apparatus. These furnaces are placed under a hood, to receive and convey away the fumes, which nevertheless escape.

In the cold no action takes place; they are obliged to commence it by the help of heat, and then a portion of the acid becomes decomposed, yields its oxygen to the metal, and is transformed into sulphurous acid gas, which is disengaged. As the silver is oxided, it combines with another portion of the acid, and forms a sulphate, which remains in solution. The solution is brisk, and the disengagement of the sulphurous gas abundant, during the two or three first hours only: after this, the progress of the operation goes on much more slowly, and it is not until the end of about 15 hours that all the metal is acted upon.

During the whole course of this operation not only is the sulphurous gas disengaged, but also the sulphuric acid; and for this reason a much more considerable quantity is employed, than combines in the decomposition: it is consequently essential to be able to guard against the corrosive action of these vapours; and therefore they are careful to place, in the funnel of the chimney, a furnace, to create a rapid

current, and carry them off; and we should also prevent, as much as possible, these vapours from spreading abroad; and it is very probable that means will be found to condense them. I think that, after having caused them to ascend perpendicularly, to disembarrass the workmen, it would be well to direct them laterally into a refrigerator of lead, which might condense the sulphuric acid, and allow only the sulphurous acid to escape; and even this might be easily absorbed, by making it pass through wooden vessels, containing lumps of lime slightly moistened.

2nd Operation.—When the sulphuric solution is finished, it is drawn off into vessels of platina, and diluted with water till it marks from 15° to 20°. We must then allow the small portion of brown powder which remains undissolved to fall down completely;—this is the gold which was contained in the silver. We decant, wash, and finally precipitate the solution of silver with plates of copper, as before described for the nitric solution. We wash very carefully the silver powder which is deposited.

3d Operation.—The silver precipitated in the preceding operation is fused in a crucible, and poured into an ingot mould.

4th Operation.—We treat the gold powder which has been separated, in the same manner, and add to it a little nitre to free it from the small portions of copper which may still remain in it.

5th Operation.—As the sulphate of copper has many uses in the arts, it is easy to procure it from the solutions which are obtained in this new process: when all the silver is precipitated, we evaporate and cause the salts to crystallize; we separate the largest crystals from the smallest, and re-dissolve the latter, to make them crystallize anew.

This is the process of refining actually in use. It remains to be shown, however, that the advantages which it offers are attended with some disadvantages, as there exist in these operations certain sources of waste, which may occasion considerable loss. For example: when we fuse a mass of silver, it frequently happens that the crucible is broken, and whatever care may be taken to collect the ashes, there is always a little deficiency. Every new crucible, also, which is used, imbibes a certain quantity of silver:—in truth, these, with all the fragments, are collected, and added to the ashes from the furnaces, to be afterwards treated in the manner of reducing silver ores: but we are here again subjected to new expenses, and the whole quantity of silver is never recovered. R.

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## *On the Uses of Albumen.**

Albumine (albumen) is a product which is found in very great abundance in the animal economy, forming the essential base of many animal fluids; such, for example, as the white of eggs, the serum of

* Translated from the *Dictionnaire Technologique*, for the Technical Repository.

the blood, the sinovial fluid, &c. This substance does not form the immediate object of any manufacture, but is of great utility in certain of the arts. Amongst the properties it possesses, we shall point out those which are most useful. Albumen readily dissolves in cold water; but heat and acids coagulate and so modify it, that it becomes totally insoluble in this vehicle. It is, nevertheless, susceptible, like other animal substances, of being combined with certain astringent and tanning matters, and of forming with them insoluble and imputrescent substances. Alcohol likewise separates it from its solutions, when they are not too much diluted.

The mention of these characters suffices to show in what manner it acts under divers circumstances in which it is employed, and more particularly in the clarifying of liquors.

When it is used to clarify a liquid which does not contain any principle susceptible of being combined with albumen, and rendering it insoluble, we have recourse to the action of heat; and in order that the albumen may act more uniformly, it is previously diluted with a small quantity of water, or of the liquid to be clarified; we then add this solution to the remainder of the liquor, and submit it to ebullition. The albumen coagulates by the augmentation of temperature; and as it is equally diffused throughout the whole mass of liquid, it seizes and entangles all the insoluble molecules, which by reason of their extreme tenuity remained in suspension in the liquid; these very minute molecules, or particles, become thickened by the addition of the albumen, and on that account it is not possible for them to pass the filters, which before would have allowed them to escape.

The same effect is produced, but for another purpose, in the cold clarifications, by albumen. Wine, for instance, contains a tanning substance, and acids in an uncombined state. The albumen being beaten up and combined with these principles, becomes concreted, and in its separation from the remainder of the liquid, it draws down all the matters in suspension, giving them more density, and determining their precipitation. Clarified wine, however, sensibly loses its astringency and acidity, and also a portion of its colouring matter, which is carried down by the albumen.

The viscosity of albumen likewise renders it useful for many other purposes. Confectioners, pastry-cooks, &c. use it, to give both lightness and whiteness to certain articles. They form it into an exceedingly white froth, by agitating it briskly with small brushes or whisks. In this manner they incorporate with it a great quantity of air, which is retained or enveloped in the albumen. This froth, mixed with paste, and beaten up with it, adds lightness to it, by introducing the air which it contains; it also gives whiteness to the articles, by more minutely dividing their molecules.

In all clarifications in the small way, the albumen of the egg is mostly used; but when large quantities are operated upon, as in sugar-refining, they use the serum from the blood of the ox, when they can procure it quite fresh, as, otherwise, it communicates to the sugar a disagreeable taste.

Finally, albumen is also used as an excellent cement. In the laboratories they often cover the lutings of their apparatus with small bands of linen, dipped in powdered quick-lime, and the whites of eggs. This kind of luting renders the joints impermeable to the most subtile gases. An analogous preparation is likewise used to cement broken porcelain and glass.

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In addition to these important applications of albumen, we may add its great value in book-binding, as a varnish for the leather covers. And also, that a letter closed or cemented with it, is not to be opened by the steam of boiling water, as when closed by a common wafer; the heat only adding to its firmness. The white of eggs beat up with water is likewise used by sign-painters, to cover over the oil paint intended to be gilt, to prevent the leaves of gold from adhering where gold size has not been laid on.

[*Editor Tech. Rep.*

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*On Improvements in Gas-Lighting. By* Thomas Gill, *Esq.*

We are glad to find that Mr. Reuben Phillips's improved mode of purifying coal gas is getting into use; he effects it by passing the gas from the retorts through a number of beds or thin layers of lime placed upon sieves laid one upon another, the lime having been previously brought to such a state, by adding more water to the hydrate of lime in powder, that it is found to adhere together, on grasping a handful of it, and can thus be spread over the sieves, leaving interstices between the coherent parts, sufficient to afford a free passage to the gas through the different layers contained in the sieves. The sieves are piled upon one another to the number of perhaps ten or twelve, each sieve having a water-joint around it, into which a rim, descending from the one above it, enters, and thus renders the joinings gas-tight. The gas, after passing only once through the lime in a pile of these sieves, is found to be sufficiently purified, and, indeed, is in danger of losing a portion of its illuminating power from being over purified. We have seen the lime after having thus performed its office, thrown out of the sieves, in the form of spherical masses, coloured yellow, green, pink, &c. and heating, and giving out steam, arising from the ammonia in the lime combining with the water in the air. This lime is found to be capable of making a good mortar, with the addition of an equal quantity of fresh lime.

By this method, the labour of turning the agitators, which are necessary in using the cream of lime to purify the gas as usual, is entirely saved; and the great nuisance arising from the stench of the impure cream of lime, removed from the washers, mixed with sulphuretted hydrogen, ammonia, &c. is completely obviated.

In those establishments, however, where the gas-washing apparatus is employed, great improvements in the use of it may be made,

by adopting the judicious system introduced by G. Lowe, Esq., in the chartered company's gas works, in Brick-lane, Old-street. Instead of suffering the above nuisance to continue, as was the case previous to his undertaking the superintendence of the works, he now evaporates the impure cream of lime, to the consistence of a thick mud, by putting it into cisterns, formed in the ash-pits of the retort ovens; and thus he not only increases the effect of the fuel contained in the ovens, by passing the steam from the evaporating water through them, but he finds that the cast-iron furnace bars will last a much longer time than before he adopted this plan. When the mud is thus formed, he spreads it over the tops of the retort ovens, and completes the drying of the lime. In this state it becomes so caustic, that the workmen who employ it in luting the mouths of the retorts, are obliged to wear gloves in order to protect their hands from the effects of its corroding action upon the skin.

Mr. Lowe lately exhibited to us, the mode he has also adopted of converting the coal-tar made in the Brick-lane works (which has accumulated in the Peter-street gas works to an enormous extent) into fuel, whereby to assist in heating the retorts. Through a hole made in the tar main above, he causes the tar to descend in a thin stream, into a funnel, fixed into the top of a bent iron pipe, which passes into the retort oven, through a small hole made in its front; here it is delivered upon the red-hot coals contained in the furnace, and is instantly converted into a bright flame, by which the retorts are uniformly heated from end to end in the most complete manner. Here again he has converted what was a nuisance, into an advantage.

In the new retort-house, erected at the Brick-lane works, under the superintendence of Mr. Lowe, he has greatly increased the comfort of the labourers employed in charging and emptying the retorts, by having only one row of ovens erected therein, and ventilating the house, by forming in the wall, opposite to the fronts of them, windows or other openings. The workmen thus, instead of being placed between two fires, as is the case in the retort-houses, as usually constructed, here perform their laborious duties in comparative comfort.

An intelligent friend informed us recently, that in the gas works at Ghent, in Flanders, where, in consequence of the high price of coals, they were obliged to extract gas from rosin, and had adopted Mr. Daniel's process for that purpose, the retorts were destroyed in so short a time, that the expenses of replacing them would have been enormous. In this predicament, and after frequent complaints had been made to him, Mr. Daniel resolved upon taking Mr. Lowe with him to Ghent, where they found the fact to be as represented. On investigating the cause of this evil, Mr. Lowe found that the retorts were destroyed not so much by the action of the fire upon them, as by the corrosion of the *pyroligneous acid*, extracted from the rosin, in converting it into gas. Mr. Lowe provided a remedy for this mischief, in the employment of lime to neutralize the acid.

The same friend also mentioned, that he had seen at the workshops of a manufacturer of gas lanterns, in London, the head of several which had been corroded so nearly through, by the action of

the sulphuric acid and water upon them, which is extricated in the combustion of the ordinary coal gas, that the finger could be passed through them with the greatest ease; and this effect had been produced in a very short space of time. The Editor, on calling upon the manufacturer to ascertain the fact, found it to be as stated; the iron being converted into rust, and nothing left but the outward coat of tin, and the paint with which it had been covered.

The foreman stated that this was a very common occurrence, and was entirely caused by the maker of the lanterns neglecting to paint the *inside* as well as the *outside* of the covers with oil-paint; and which his employer constantly made it a point of doing, not only on first sending them out of his manufactory, but he also periodically renewed the painting afterwards; and that in this way, and by this cheap and simple expedient, the lanterns were made to endure for a considerable length of time. [*Tech. Rep.*

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*On an effectual cure for Smoky Chimnies. By Mr.* S. Mordan.

Mr. Mordan, the patentee of the ever-pointed pencils, showed the Editor lately his contrivance for preventing his kitchen chimney from smoking, and also for quickly exciting his fire, without the aid of bellows.

His fire-place, like many others, had a wide open chimney to it, and was continually annoying his family by smoking. He determined, therefore, to contract the throat of his chimney in the following judicious manner:—He caused the entire opening at the bottom or throat of the chimney to be closed up, with the exception of an upright flue, just above the top of the grate, about a foot wide and high, and which led into the chimney. To the face of this flue he applied a square flat frame of wrought-iron, having upright grooves made on each side of it, in which a sort of hood, made of sheet-iron, could slide up and down. This hood is open behind, and projects about a foot square in front of the chimney back, over the fire-place or grate, and is sloped off at its top, towards the back of the chimney, and it has a handle in the front of it to raise and lower it by.

When the hood is elevated, it serves to guide the smoke and heated air into the upright opening leading into the chimney, its sides being closed to fit the upright back of the fire-place; and the fire then burns in the usual manner, but the chimney never smokes. When, however, he wishes to excite the fire at any time, he lowers the hood until its bottom nearly reaches down to the tops of the cheeks, or two keepers of the grate, and the fire, by the draught thus caused, instantly revives. In addition to this hood, he likewise occasionally hangs upon ledges, formed upon each side of it, an appendage made of sheet-iron, which lengthens it so that its sides fit close upon the tops of the keepers, and thus the air can only gain access to the fire through the front and bottom bars of the grate, and then, indeed, the fire burns most vehemently. [*Ib.*

*On the Preparation of Hemp and Flax without Water-Retting.* By M. Nicolas.*

In order to avoid the evils of water-retting, M. Nicolas, after having accurately analyzed hemp, proposes to obtain its filaments, as well as those of flax, by simply exposing the plants to the action of the dew (dew-retting;) he remarks that the process is practicable every where, and that it does not give any offensive smell to the hemp, nor injure its quality. This easy process is already employed in the Department of the Vosges, where, beyond doubt, it was first practised; and M. Nicolas, in now pointing it out to notice, proves that it has been overlooked in the modern improvements of the art; and finishes, after his successful experiments, by reverting to the fact, that it is the very means indicated by nature.

M. Nicolas, however, afterwards employs an active and cheap solvent to free the hemp from its gummy resinous parts, which resist the action of the dew. He puts into a tub one hundred pounds of the filaments, bound and tied into bundles or handfuls; and to bleach the fibres he makes a mixture of fifty pints of spring water, to which he adds two pounds of potash; when the solution is effected, he adds four pounds of common oil, and by the assistance of heat, forms a saponaceous liquid, marking about twenty degrees of the areometer, and which he then pours upon the hemp in the tub. He withdraws this lie in two days' time, and heats it to eighty-five degrees of the centigrade thermometer, when he again pours it upon the hemp. On the third day he rubs the filaments between his hands, to wash them thoroughly; and lastly, dries them. In this process the fibres become soft, they make but little tow, and are very readily spun. [*Ib.*

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*On preserving Wines in Draught.* *By* M. Imery.†

M. Imery, of Toulouse, has given us the following simple means of preserving wine in draught for a considerable time; it is sufficient to pour into the cask a flask of fine olive oil. The wine may thus continue in draught for more than a year.

It is by a similar process, that they preserve wine in Tuscany, which they are accustomed to keep in large bottles, the glass of which is too thin to resist the effect of corking them tight. The oil, spread in a thin layer upon the surface of the wine, hinders the evaporation of its alcoholic part, as well as prevents it from combining with the atmospheric air, which would not only turn the wine sour, but also change its constituent parts. [*Ib.*

* From *Mémoir de la Soc. Royale de Caen*, and Ferussac's *Bulletin des Sciences Technologiques.*

† From *Journ. des Science Usuelles*, and Ferussac's *Bulletin des Sciences Technologiques.*

## *On Bleaching Sponge. By* M. Vogel, *of Munich.**

Although sponge, in its chemical nature, very much resembles silk and wool, yet it cannot be bleached in exactly the same manner as those substances. M. Vogel was convinced that the bleaching of it would be the more difficult, as the action of the vapour of burning sulphur upon it reduces it so considerably, or, as we may say, almost to nothing; whilst both silk and wool, as is well known, are bleached by this means in a most complete manner. The finer the sponges, the more easily they are bleached. The following method has succeeded extremely well for this purpose:—

The sponges must first be sufficiently steeped in cold water; for if they were to be put into either boiling or even warm water, it would produce a most destructive effect upon them; as they would shrink, their pores would be closed, they would become hard, and it would be impossible to bleach them afterwards.

But if the sponges are steeped in cold water, which should be changed every three or four hours, and if at each time it is changed they were submitted to so strong a pressure as to be entirely freed from the water, at the expiration of five or six days they would become sufficiently washed, and be prepared for the bleaching.

If, as it frequently happens, the sponges retain, in their interior, small calcareous stones, which it might be supposed could not be extracted without tearing them or beating them to pieces, yet it is easily effected by allowing them to steep for 24 hours in muriatic acid, diluted with 20 parts of water: this produces a slight effervescence, from the extrication of the carbonic acid gas; and the calcareous concretions disappear, being dissolved in the most complete manner.

Then, after having been very carefully washed, the sponges are thrown into a solution of sulphurous acid, of the specific gravity of 1,024; or which marks about 4° on the areometer of Beaumé. The following is the best manner of preparing this acid:—Put into a glass retort, one pound of pulverized charcoal, and one pound of concentrated sulphuric acid; and, by means of a bent tube, convey the gas, which is extricated, into a vessel, where it may be combined with eight pints of water, according to the Bavarian measure.†

The immersion of the sponges in this acid is to be continued for eight days; but during this time they are to be repeatedly submitted to the action of a press; and, lastly, they are allowed to remain 24 hours in running water.

When the sponges have thus been washed in a sufficient quantity of running water, they may be sprinkled with rose or orange-flower-water, for the purpose of communicating to them an agreeable odour; after which, they must be allowed to dry gradually in the open air.

* From *Archiv. fur die gesammte Naturlehre*, Vol. I. No. II. p. 248.

† It might, probably, answer the purpose, to combine the gas first with two pints of water, and afterwards, to dilute the acid with six pints more, when it is to be used for bleaching the sponges.

## NATURAL HISTORY.

### *Notes on the Rattlesnake.* *By* John James Audubon, F.R.S.E., M. W.S., &c.*

The power of fascination gratuitously ascribed to most snakes by theoretical naturalists, has so long riveted the attention of all persons inclined to think on the subject, but without the means of judging for themselves, that the following fruits of many years' observation, in countries where snakes abound, will not, I hope, though adverse to the supposed power of fascinating, be looked upon as destitute of interest.

Rattlesnakes in particular appear to have acquired their chief fame from this supposed charm. I shall, therefore, draw your attention more directly to the habits of that species, and begin by enumerating the many real and extraordinary faculties bestowed upon it. These consist in swiftness; in powers of extension and diminution of almost all their parts; in quickness of sight; in being amphibious; in possessing that wonderful and extraordinary benefit of torpidity during winter, and long-continued abstinence at other periods, without, however, in the mean time losing the venomous faculty, the principal means of their defence. I shall proceed to elucidate, by well-authenticated examples, all those different faculties.

Rattlesnakes hunt and secure for their prey, with ease, gray squirrels that abound in our woods; therefore they must be possessed of swiftness to obtain them. Having enjoyed the pleasure of beholding such a chase in full view in the year 1821, I shall detail its circumstances. Whilst lying on the ground to watch the habits of a bird which was new to me, previous to shooting it, I heard a smart rustling not far from me, and turning my head that way, saw, at the same moment, a gray squirrel full grown, issuing from the thicket, and bouncing off in a straight direction, in leaps of several feet at a time; and not more than twenty feet behind, a rattlesnake of ordinary size pursuing, drawn apparently out to its full length, and sliding over the ground so rapidly, that, as they both moved away from me, I was at no loss to observe the snake gain upon the squirrel. The squirrel made for a tree, and ascended to its topmost branches as nimbly as squirrels are known to do. The snake performed the same task considerably more slowly, yet so fast, that the squirrel never raised its tail, nor barked, but eyed the enemy attentively as he mounted and approached. When within a few yards, the squirrel leaped to another branch, and the snake followed by stretching out full two-thirds of its body, whilst the remainder held it securely from falling. Passing thus from branch to branch with a rapidity that astonished me, the squirrel went in and out of several holes, but remained in none, knowing well that, wherever its head could enter, the body of his antagonist would follow; and, at last, much exhausted and terrified, took a desperate leap, and came to the earth with legs and tail

* Read before the Wernerian Natural History Society, 24th February, 1827.

spread to their utmost to ease the fall. That instant the snake dropt also, and was within a few yards of the squirrel before it had begun making off. The chase on land again took place, and ere the squirrel could reach another tree, the snake had seized it by the back, near the occiput, and soon rolled itself about it in such a way that, although I heard the cries of the victim, I scarcely saw any portion of its body. So full of its ultimate object was the snake, that it paid no attention to me, and I approached it to see in what manner it would dispose of its prey. A few minutes elapsed, when I saw the reptile loosening gradually and opening its folded coils, until the squirrel was left entirely disengaged, having been killed by suffocation. The snake then raised a few inches of its body from the ground, and passed its head over the dead animal in various ways to assure itself that life had departed; it then took the end of the squirrel's tail, swallowed it gradually, bringing first one, and then the other of the hind legs parallel with it, and sucked with difficulty, and for some time, at them and the rump of the animal, until its jaws became so expanded, that after this, it swallowed the whole remaining parts with apparent ease.

This mass of food was removed several inches from the head in the stomach of the snake, and gave it the appearance of a roleau of money brought from both ends of a purse towards its centre; for, immediately after the operation of swallowing was completed, the jaws and neck resumed their former appearance. The snake then attempted to move off, but this was next to impossible; when having cut a twig, I went up to it, and tapped it on the head, which it raised, as well as its tail, and began for the first time to rattle. I was satisfied that for some lapse of time it could not remove far, and that the woods being here rather thin, it would soon become the victim of a vulture. I then killed it, and cut it open to see how the squirrel lay within. I had remarked, that after the process of swallowing was completed, singular movements of the whole body had taken place,—a kind of going to and fro for a while, not unlike the convulsive motion of a sick animal, as a dog, for instance, about to vomit. I concluded that some internal and necessary operation was going on. This was proved when I found the squirrel lying perfectly smooth, even as to its hair, from its nose to the tip of its tail. I noted all this on the spot. This over, I sought my game again, and felt a great satisfaction; but having met my friend, Mr. James Perry, on whose lands in the State of Louisiana I was then hunting, and having related what had just happened, he laughingly said, "Why, my dear sir, I could have told you this long ago, it being nothing new to me." These facts, I trust, are quite sufficient to exemplify the faculties of swiftness, and the powers of extension and diminution in the rattlesnake. In regard to quickness of sight,—I have several times discovered a snake to be near me from a sudden and brisk rustling amongst the dead leaves or grass, as a vulture or forked-tail falcon was passing over the place in search of food, and by close investigation discovered that some snake had made away to hide under a log, root, or stone, from its winged enemy; for, after being satisfied that

the noise thus heard was produced by snakes labouring to escape through fear, I have remained snug and silent, and have seen them issue from their covert when the vulture had gone by. But, further, I have frequently seen them move their heads sideways, looking up to the trees, and discovered that they were then in search of birds' nests; and so watchful of the parent's motions, that, as if afraid to suffer by the encounter with a bird of size and power, they made choice of the time when both parents were absent, to ascend and rob them either of the young or the eggs, if not fully laid and ready for incubation. Should the snake, in such attempts, be perceived by the owners of the nest, their cries of alarm and attack are heard through the woods, and so many other birds assemble and pour in from all sides, that it becomes nearly impossible for the snakes to make good their retreat. I shall merely add, that those battles and defeats are corroborated by one of our most eminent naturalists in America.

That almost all snakes can swim, and do swim well, too, and can remain under water a considerable time, is a fact sufficiently ascertained; but that, in this element, they have the power of pursuing fish, and of catching either them or frogs, is a fact which, though equally true, is not so well known. I shall, therefore, present to you some proofs of this from my own observation. Whilst fishing on the banks of the Schuylkill river, not very far from Philadelphia, about twenty years ago, I saw a snake issue out of the water close to me, and slide up a large stone to receive the benefit of the sun. I perceived it to be swelled about its middle, and shot it to ascertain its contents, when I discovered in the stomach a cat-fish scarcely dead; so fresh, indeed, that I made it my prize, and felt no ways alarmed at eating it when dressed. Since that time I have had opportunities to see snakes chasing bull-frogs, follow them after they had leaped into the water, and return with them in their mouths. Several other species, indeed, make the water their almost constant place of abode, one of which the Congo (*C. nigra,*) an extremely venomous snake, is found in great numbers in all the lakes and watery swamps of the Southern states.

Periodical torpidity in snakes, as in almost all animals subject to it, has been wisely ordered, on account of the very slow growth granted to most of them. Snakes, as well as alligators, increase in size very slowly, and are, consequently, long-lived; but how transient, if needed, this most wonderful power granted them to live, to die (as it were,) and to live again, is, I shall try to describe by the following curious fact:—M. Augustine Bourgeat, whose name will be ever dear to me, my younger son, and myself, where hunting one winter-day for ducks, and having halted awhile near a lake, we struck up a fire. Being desirous to eat what we were pleased to call our dinner, we began picking and cleaning some of our game. The youngest of our party ran about for wood, and, anxious that a good supply should be at hand, attempted to roll a log, at a short distance, towards the spot pitched on. In doing this, my son discovered so large a rattlesnake closely coiled up, in a torpid state, that he called us to come and look at it. It was stiff as a stone, and, at my request, my son

put it into my game-bag, then upon my back, for further observation. Shortly afterwards, whilst our game was roasting upon the wooden-forks, stuck in front of our cheerful fire, I felt something moving behind me, which I thought for a moment was occasioned by the struggles of a dying duck; but presently recollecting the dangerous animal, I begged my friends to see if it was not the snake; and being assured that it was, the time employed in unstrapping and throwing off the bag with the reptile, was, I assure you, of very short duration. The snake was then quite alive, issued from the bag, and began rattling, with its head elevated, and thus ready, while the body was closely coiled, to defend itself from all attacks. The distance at which it then was from our fire, and the consequent cold, would, I thought, soon conquer it: and in this I was not mistaken; for, before our ducks were roasted, the snake had stopped its alarum, and was bent on finding a place of refuge, again to become torpid. Having finished our meal, my son, who had watched all its movements with the eagerness of youth, brought it again, with a smile, saying, "Papa, look at Hercules and the serpent!" We took it home, and it became torpid, or revived, at our pleasure, as often as we removed or brought it near the fire; until having put it in a jar of spirits, it travelled to the Lyceum of New York.—That all their faculties become dormant, and remain virtually dead during torpidity, I have ascertained, by finding snakes with great quantities of food in the stomach, frozen and undigested, although it had been there for several weeks; when, if the snake was removed to a warm situation, the operation of digestion was daily perceptible, and the whole food in a short time consumed.

Rattlesnakes have the power of laying down their fangs along their jaw-bones when at rest, and of raising them again at will; as sharks also do, and some other fishes. It is only when inflicting a *defensive* wound that their fangs are used. At this time, the snake, either coiled, or in any other position, has the power of darting about two-thirds of its body towards its object, and, with its mouth open to its utmost stretch, all its fangs being erect, it strikes so violent a blow whilst it bites, that I have been assured, by some Osage chiefs, that on such occasions, they felt, when struck, as if about being thrown off their centre of gravity. The fangs make their way into flesh, or indeed, tough leather, with perfect ease, and instantaneously. The wound is generally mortal, if proper remedies be not at once resorted to. Among the *native Americans*, cutting out the wounded part, and searing, or, as it is termed in the country, *scaring* it with fire, is considered the most effectual,—but even this requires great promptitude to afford a chance of safety. The quantity of venom infused is more or less, as the animal may have been more or less irritated. If made to bite themselves, their own flesh affords no antidote, for they die in excruciating torments. The venom of a rattlesnake, while the animal is striking against any object, will be sometimes ejected to a considerable distance. I have seen one confined in a wire-cage, when much enraged, strike against the bars so furiously, that the poison was sent several feet towards me.

I have been told by native Americans, that arrows dipt in rattlesnake venom, would carry death for ages after.

Some European writers of great eminence have asserted, that rattlesnakes are destroyed by hogs in such quantities that the introduction of the latter into any country would soon clear it of the former. In the United States, where hogs are very numerous, I never witnessed any one attempt to kill a rattlesnake, and have, on the contrary, remarked that hogs were shy of these reptiles; but if this were not the case, the ease with which rattlesnakes can either make their escape, or defend themselves, is such, that the hog would, in preference, I think, avoid the danger, and without risk, feed on congenial food, which is ever under his nose, and in great abundance throughout all our woods, unless, indeed, the hog were endowed with the power of fascination, a thing not yet communicated by those writers. But why, I would ask those closet naturalists, do not the rattlesnakes fascinate their opponents the hogs as well as birds?

The flesh of rattlesnakes was considered a dainty by the Spaniards, whilst in possession of Louisiana. Mr. James Perry, a principal alcaide in the parish of St. Francis at that period, has assured me, that the officers garrisoned on the heights of Fort Adam, were in the habit of giving premiums to the soldiers and Indians who brought them the largest and fattest. The head being cut off, the snake was suspended, so as to become entirely drained of its blood, and the flesh cooked as that of chickens, which it much resembles. Their skins were tanned, and beautiful shoes are still made with them, which retain all the variegated marks exhibited on the scales of the animal when alive.

Perhaps one of the most wonderful faculties possessed by this and many other species of snakes, is that of being able to live for years without any food whatever; and quite as remarkable, that, during the lapse of this astonishing fast, their appearance and condition scarcely exhibit their being in any want. Their movements, the power of rattling, and that of inflicting mortal wounds, are perfectly kept up. One which I confined in a cage for three years had frequently rats, young rabbits, and birds of various kinds put in, sometimes alive, and at other times dead, without their ever being touched; not even a movement would be made by the snake to approach them; while, on the contrary, the live quadrupeds and birds showed great symptoms of fear, and threw themselves violently in all directions about the cage, to effect their escape from an enemy well known to them. The operation of throwing off its skin annually was, however, abandoned, after the first spring of confinement; and, as the indivividual was small, and I did not consider it as arrived at its middle age, I measured its length with accuracy, and discovered, that, during the whole time of its imprisonment, it did not grow in the least. To what extent this power of abstinence is ever used, when the animal is at liberty, I am unable to tell, but I have thought, that the animal possessing it so eminently, went a great way towards proving that it had not that of fascination; as it would be very unnatural for an animal so gifted to lie and suffer, while the single glance of a magnetic

eye could bring down a bird at once from the top of any tree into its mouth.

I now and then turned the snake out of its cage, when, with great quickness, it would go about the room, looking in all directions, with a view to effect its escape. As I was armed with a long stick, it never made towards me, but if I put myself in its way, it would stop, prepare for action, and rattle until I removed, and afforded it a free passage.

Rattlesnakes are easily disabled, and afterwards killed. A single smart blow, even of a slender twig, will disjoint any part of the vertebræ, after which they lie at your mercy.

The mode of copulation used by these reptiles is so extraordinary, that I must not omit a description of it, as it is my chief purpose to record any facts regarding them that may be novel, or but little known. Early in spring, as soon as the snakes have changed the skin that contained their last year's growth, they issue brightly coloured, glistening with cleanliness, and with eyes full of life and fire. The males and females range about, in open portions of the forest, to enjoy the heat of the sun, and, as they meet, they roll and entwine their bodies together, until twenty, thirty, or more, may be seen twisted into one mass, their heads being all turned out, and in every direction, with their mouths open, hissing and rattling furiously, while, in the mean time, the secret function is performed. In this situation they remain for several days on the same spot, and the danger of approaching such a group would be very great; for, at sight of any enemy to disturb them, they all suddenly disengage, and give chase. The fact of their rattling, which tends to alarm intruders, and to warn them of their danger, is too well known to call for any observations regarding it.

To conclude: suffer me to call to your recollection a well known fact, that birds of all kinds are full of courage; that even the smaller tribes will attack, and chase before them, the larger kinds, and that those again will even defend themselves from man, and often with success. Have we not all seen the little robin chase a cat? An eagle will keep off a man from her nest, and a cock will attack even a lion. This being the case, why should they suffer their senses to sink in sleep before a reptile, when, with a few mere flaps of their wings, they can so easily escape? After this reflection, can we for a moment imagine, that the Creator has exposed the feathered race to such dangers as the power of fascination would imply? We may rest assured, that, when snakes destroy birds, or any other animals, it is by the quickness of their motion, and the acuteness of their sight, seconded by cunning and strength, but never by fascination.

*Mode of Condensing and Preserving Vegetable Substances for Ships' Provision, &c.*

The quantity of liquid matter which enters into the constitution of vegetables is very great; when they are deprived of it their bulk is very trifling. That preparation of animal food, called *pemmican*, in which six pounds of meat are condensed into the space of one, is mainly effected by abstracting all the fluid from it. Vegetables may be treated in the same way: let them undergo the process of boiling over a fierce wood fire, so as to preserve their colour when *completely* cooked; grind them into a complete pulp by some such means as are used to crush apples for cider, &c.; then let them be subjected to the action of the press, (being first put into hair bags, or treated as grapes are in wine countries,) till all the fluid matter is separated from them; the remainder of their substance becomes wonderfully condensed, and as hard as the *marc* from the wine press. Then let it be rammed hard into carefully glazed air-tight jars, (or tin cases, if preferred,) and subjected to the Appertian process for preserving animal and vegetable matters (well known, by-the-by, to our grandmothers, who preserved gooseberries in this way from time immemorial.) If jars are used, they may be sufficiently secured by having two pieces of bladder tied successively over them; when the air within is absorbed by heating the enclosed substance, their surface becomes concave by the pressure of the atmosphere, and as long as it remains in this state the matter within is safe. If it should be thought requisite to preserve the flavour of the vegetables entire, an extract should be made from the expressed liquid, and added to the *marc*. But spinage, cabbage, and many others, have abundance of flavour in them in their dry state without this addition. The preparation of the vegetable matter for use, is accomplished by adding a sufficient quantity of milk, water, gravy, lime-juice, &c., to the *marc*, and warming it up. Let the government, and the dealers in ships' provision, look to this; a sufficient quantity of this *vegetable pemmican* would be the greatest luxury to a ship's crew, and render the scurvy utterly obsolete. It is worthy of remark, that the most irritable stomach is not offended by vegetables treated in this way.

[*Qu. Jour. of Science.*

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*Experiments with Bottles sunk into the Sea. Made during a voyage from New South Wales. By Mr.* James Dunlop.

*Experiment* I.—April 9, 1827, in lat. 24° South, and long. 43° 10′ West, the ship becalmed off Rio de Janeiro, the boat was lowered down, and rowed a short distance from the ship; the deepsea lead was let down eighty fathoms, with the following experiments attached to it, consisting of a common porter-bottle, well corked and pitched over, and secured by a covering of new canvass, which was also covered by a thick coat of pitch; also a tin canister, with

holes pierced in its bottom, and open at the top, in which were placed four small thermometer tubes filled with mercury, all of which would burst with a less temperature than 100° of Fahrenheit; also five small glass globes hermetically sealed by the blow-pipe, two of which were vacuum (or as nearly so as I could make them,) other two were suffered to cool, previous to their being sealed, and the fifth contained a small globule of mercury, to enable me to detect any damp, as an experiment of the porosity of glass; three glass phials, well corked, and firmly secured by leather coverings, tied round the necks, and further secured by a coating of sealing-wax, were also put into the canister. After letting them remain ten minutes at the depth of eighty fathoms, the line was hauled in, and the experiments examined. The porter-bottle was nearly filled with water, and the cork floating inside; the covering of canvass and pitch was pressed concave into the mouth of the bottle, but the pitch was not cracked or broken. The four thermometers, and also the small glass globes, came up unbroken. I examined the one which contained the small globule of mercury, and it gave not the slightest indications of damp having penetrated through the glass. The three phials came up full of water: of one of them the cork was forced in, and swimming in the water; in another, the cork was forced about half an inch into the neck; and the cork of the third was not apparently affected, or displaced, in the least degree, although the phial was full of water, and also several pieces of the sealing-wax lying in the bottom, which could by no means have got into the bottle, but by the cork being driven in. The wax on the top of each was broken or cracked in regular concentric rings from the centre, and the coverings of leather burst, as well that in which the cork was not displaced as in the others. Indeed, the hole in the leather which covers the phial with the remaining cork, is larger than in the others, in which the cork is driven in; which, in all probability, may be accounted for, by considering this cork to have been tighter fitted into the phial, and requiring a greater force to displace it: there would be a greater rush of the water into the phial, and the cork forced again into its neck. I think it more than probable this has been the case, otherwise the bits of sealing-wax could not have got into the phial had the cork retained its station; neither could we account for the bursting of the leather and wax which fastened down the cork.

In preparing for the second set of experiments, I attempted to guard against the possibility of the corks being forced in, or the pressure of the circumincumbent column at all affecting the corks. I prepared two (four or five ounce) phials: the corks were dipped in strong gum dissolved in ether, and thrust into the mouth of the phials; they were allowed to remain in this state for several days to dry. The corks were then cut close to the mouth, and covered with several thick coats of varnish, and afterwards covered with leather, firmly tied round the neck, which was also covered or soaked in varnish, and suffered to dry; and for further security, the heads and necks of the phials were immersed in brass caps, filled with melted sealing-wax, to prevent the possibility of pressure upon the corks. I also

prepared a small phial by simply thrusting in the cork as tight as possible, and cutting it close to the mouth, and afterwards covering the mouth and neck of the phial one-fourth of an inch thick with black sealing-wax.

On the 15th of May, in lat. 5° North, and long. 26° West (the ship becalmed,) these three phials were wrapped in old canvass, and, together with the thermometers and glass globes used in the former experiments, were all put into a tin case, open at the top, and fastened to the line just above the lead: a porter-bottle fitted up as formerly, was also attached to the line. The boat was rowed a short distance from the ship, and the lead let down one hundred and eighty fathoms, and allowed to remain about eight or ten minutes at that depth before we commenced hauling in the line. On examining the experiments, the two (five ounce) phials, which were secured by the brass caps, were broken or crushed to powder, with the exception of the thick part of the bottom, and the neck which was protected by the brass caps. The other small phial, which was much stronger in the glass, and only secured by the cork, covered one-fourth of an inch thick with sealing-wax, was not broken or injured in the least, though a very minute quantity of water had found its way into the phial, probably through the wax and cork; and, I have no doubt, had the phial been allowed to remain a sufficient time at that depth, that it would have filled with water, probably without breaking the wax, or forcing in the cork. Neither the thermometers nor the small glass globes were broken, nor could I perceive the slightest appearance of damp in the small globe which contained the globule of mercury, to indicate porosity in the glass. The porter bottle came up full of water as formerly.

The porter bottle in this, and also in the other experiment, was prepared by Captain Mood, commander of the Portland, who assisted, and gave every facility for making experiments, when the weather, and other circumstances, would permit.

My object with the thermometer, was to ascertain whether an increase of temperature took place at a considerable depth in the ocean; and not being provided with a self-registering thermometer, the only resource I had was to make several, about three inches long, and by immersing the bulbs in water heated to a known temperature, the superfluous mercury was forced out; and the moment it began to subside, the tube was sealed by the blow-pipe. The one which indicated the lowest temperature, required but 73° or 74° of Fahrenheit to raise the mercury to the top of the stem; but experiment proved the unsatisfactory results I might have expected, as it required a temperature of above 80° to burst the slender bulb. The experiments of Captain Sabine and others prove the temperature of the ocean to decrease at considerable depths below the surface.

I think it can hardly fail to convince any one who makes the experiment of sinking bottles in the sea, and assists personally in the hauling in of the line, that the great force necessary to haul it in must be occasioned by the pressure of the superincumbent column of water. And I have no doubt that the same experiment may be

performed, and powerful effects produced, on a bottle well corked and secured, being placed in a cast-iron cylinder filled with water, and the *force applied by a hydrostatic press*, on the top of a solid piston (which must be well fitted into a smaller cylinder fixed on the top of the larger one,) the piston pressing upon the surface of the water in the small cylinder. And many interesting experiments might be performed in the lecture room, by substituting a very strong cylinder of glass, having its ends ground parallel, and fitted into brass caps accurately ground to fit the outside of the ends of the cylinder, and the bottom of the caps lined with leather, to prevent the pressure of the screws, necessary to connect the caps, and keep them water-tight, from chipping the glass. To one of the brass caps must be fixed a well-bored cylinder, for the solid piston to slide in, &c. Sea-water might be used in the cylinder, with a thermometer to show what capacity water may have to retain its caloric when under a high pressure. Such experiments would be interesting to compare with experiments which have been made on the temperature of the sea at great depths; and also the specific gravity of the water in the cylinder ascertained before and after the experiment, which would probably throw light on the subject of increased specific gravity of water drawn from great depths, and also whether the effects of pressure on water are permanent, and owing to the imperfect elasticity of water. [*Jameson's Edinburgh Journal.*

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## *Diet in Britain and France.*

What is called the influence of climate on the human species, may be resolved, we suspect, chiefly into the effects of diet, which necessarily varies with the geographical position of each country. Thus, in cold climates, the stomach prefers animal food, and calls for, or, at least, comes more readily to relish, the stimulus of ardent spirits; while, in regions nearer the sun, men subsist chiefly on bread, and fruits, and prefer the mild produce of the grape to strong, brewed, and distilled, liquors. The French are more sober than the Germans, because the warmer temperature of their country enables them to substitute wine for the ale, and rye-brandy, of their neighbours. The Spaniards again are more sober than the French, for reasons not so obvious, but which still resolve themselves into the effects of climate. In the hot soil of the Peninsula, the orange, citron, and a multitude of other juicy fruits, come to perfection, which do not succeed in France; and the delicious cooling drinks which these afford, indispose the stomach for spirituous stimuli, and render even wine less necessary. Madame de Stael attributes the stern tempers and gloomy mythology of the northern nations, to the perpetual fogs and rigorous winters of their climate. To some extent she may be right; but we question if the peculiarities she speaks of may not be considered as partly the effect of that depression of

animal spirits which fills up so large a portion of the life of those who are constantly addicted to the use of violent stimuli.

The characteristic of the southern nations of Europe is not so much positive gaiety, as an equable flow of the animal spirits. They are less the slaves of care than the people of the north, and more disposed to snatch the frivolous and fleeting pleasures which the hour presents. As they do not seek the exaltation which intemperance gives, they are strangers to the mental depression which follows it. The Frenchman is habitually ready to enter into a hundred small schemes of amusement, which the Englishman affects to despise, while he secretly envies the elasticity of spirit that gives their zest. The latter, (we include the Scotsman too,) proud and anxious, never lays aside his phlegm till deep drinking has made him boisterous and quarrelsome. There are four articles which have produced an extraordinary change in the mode of living of the European nations in recent times—tea, coffee, sugar, and tobacco. The introduction of these into common use is one of the most singular achievements of modern commerce. Three centuries ago, who would have believed that the produce of China and the West Indies would now form the daily food of our menial servants and labourers! The following tables, compiled from authentic documents, throw light on the habits of the two most distinguished nations of Europe.

Quantities of sugar, tea, &c. consumed in Britain and France:—

| | | Britain. | France. |
|---|---|---|---|
| Sugar (1824) | lbs. | 448,000,000 | 128,000,000 |
| Tea (average) | do. | 22,750,000 | 195,000 |
| Coffee (1824) | do. | 8,100,000 | 20,100,000 |
| Tobacco (do.) | do. | 16,900,000 | 7,200,000 |
| Wine (do.) | Old Gal. | 6,210,000 | 700,000,000 |
| Spirits (1826) Foreign 3,960,000 / Home 24,060,000 | do. | 28,020,000 | 5,700,000 |
| Beer (1826) | Ale Galls. | 420,000,000 | 155,000,000 |

But, in order to come to correct conclusions, we must always take into account the numerical amount of the population of the two countries. In the following table we have therefore calculated what the consumption is for one million of inhabitants in each.

| | | For one million Of Englishmen. | Of Frenchmen. |
|---|---|---|---|
| Sugar | lbs. | 22,400,000 | 4,270,000 |
| Tea | do. | 1,137,000 | 6,500 |
| Coffee | do. | 405,000 | 670,000 |
| Tobacco | do. | 845,000 | 273,000 |
| Wine | Old Galls. | 310,000 | 23,300,000 |
| Spirits | do. | 1,400,000 | 190,000 |
| Beer | Ale Galls. | 21,000,000 | 5,170,000 |

[*Mechanics' Register.*

### *On Lightning Rods and Compasses. By Dr.* Fischer.

Dr. Fischer states, that when iron is magnetised it loses much of its conducting power for ordinary electricity; and concludes from his observations, that iron, which is known to become magnetic by even feeble electric explosions, is a very improper metal for the construction of lightning rods. He relates an instance in which a rod of this metal, placed as a lightning-conductor upon a powder-magazine, had entirely failed on several occasions in preventing the explosion of lightning close by its side. Upon examining this rod, it was found to have attractive and repulsive magnetic properties.

M. Fischer consequently recommends copper as the metal to be used, and advises that the end be gilt or made to terminate in a gold point, rather than with platina, because the former is so much superior in conducting power.

The conclusions of M. Fischer with regard to the decrease of conducting power in iron, when magnetised, are in singular contrast to the assertions of Mr. Abraham, who states that the conducting property is wonderfully increased by making iron magnetic, and recommends that all lightning-rods be of magnetised iron. We doubt whether any effect is produced either way.

M. Fischer endeavours to prevent the disturbance of the magnetic needle from neighbouring masses of iron, by placing it in a bowl of that metal of equal thickness throughout. He states, that the needle points north and south, and is not affected by the approximation of iron. The means are the same, generally, as those practised some years ago in this country by Mr. Jennings, who surrounded his needles with a strong ring of iron. The effect is also stated to be the same.

Mr. Abraham used two cast-steel rods, properly hardened and tempered, each three feet in length, and half an inch in diameter; one end of each bar was hammered to a fine point, and one bar was rendered magnetic; then a brass ball was placed two inches off from the prime conductor of a machine, and the points of the unmagnetised and magnetised bars brought alternately towards it; the magnetic bar (it is said) prevented the passage of sparks between the conductor and ball when it was twelve inches off, whilst the other required to be brought to within nine inches.

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### *Signs of Increase, Maturity, and Decay in Trees.* *By* M. Baudrillart.

The qualities of wood depend much on the state of the tree when cut down. It appears, from the experiment of M. Harting upon wood applied as fuel, that trees which have attained maturity without passing into decay, are the best for the production of heat. Thus the value of an elm of one hundred years is to that of one of thirty

years, as twelve is to nine; that of an ash of one hundred years to one of thirty years, as fifteen to eleven. When the trees begin to decay, their value rapidly diminishes; thus, if an oak of two hundred years yields wood worth fifteen francs per cord, a tree of the same kind passing to decay yields wood only worth twelve francs. When the wood is used for other purposes, the advantages conferred by a mature, but healthy state, are still more considerable.

The common elm, growing in a forest and in good earth, acquires its full increase in about one hundred and fifty years, but it will live many ages, even five or six hundred years. Large forest elms are cut down with advantage when of an age between one hundred and one hundred and thirty years, and then furnish a large quantity of building wood. The duration of the life of an elm depends much upon the soil; in a dry soil it becomes aged, as it were, in forty, fifty, or sixty years. Elms which have been lopped, live for a shorter period than the others. Those which grow by the road side, or in thin plantations, may be cut when seventy or eighty years of age. In general, the increase of hard woods, as the oak and the elm, is small at first; it successively augments until the twentieth or twenty-fifth year, is then uniform until the age of sixty to eighty years, after which it sensibly diminishes.

For these and others reasons, it is important that trees should be cut down when they are at their mature state, and not simply when they undergo no further increase. When the period has arrived after which the increase of the tree would be less and less from year to year, then the tree should be felled, for no advantage accrues from its remaining longer in the ground. The indications of the mature state of a tree are by no means so evident as those of decay, but still certain signs of these states, as well as of the vigorous condition of the tree, may always be observed.

### I. *Signs announcing the vigour of a Tree.*

The branches, especially towards the top, are vigorous; the annual shoots strong and long; the leaves green, vigorous, and thick, principally at the summit, and falling late in autumn; the bark is clear, fine, united, and nearly of the same colour from the foot to the large branches. If at the bottom of the veins, or divisions, of the thick bark, there appear smaller divisions which follow from below, upwards, in the direction of the fibres, and live bark be observed at the bottom of these divisions, it is an indication that the tree is very vigorous and rapidly increasing in size. If some of the lower branches, stifled by the others, are yellow, languishing, and even dead, this is an accidental effect, and is no proof of the languor of the tree. Finally, it is a sign of vigour when branches are seen at the summit of the tree, rising above and being much longer than the others; but it is to be observed that all trees with round heads do not throw out branches with equal force.

### II. *Signs which indicate that the Tree is mature.*

Generally the head of the tree is rounded; the shoots diminish in length each year, and the furthest shoots add to the length of the

branches only by the length of the bud; the leaves are put forth early in spring and become yellow in autumn before those of vigorous trees, and at this time the lower leaves are greener than the upper. The branches incline towards the horizon, and form angles sometimes of sixty or seventy degrees. These apparent signs, and the thinness of the layer deposited by the sap, indicate that the tree makes but small additions to itself, and now it should be cut down. The nature of the earth should be examined, as well also as the kind of tree, to form a judgment whether the tree should be left to increase still further, or whether it will be more proper to fell it. An exact age cannot be assigned for each species; but it has been observed, that an elm situated in an insulated plantation may be felled with advantage when between seventy and eighty years of age.

### III. *Signs of decay in a Tree.*

When a tree becomes crowned, *i. e.* when the upper branches die, it infalliby indicates, especially for isolated trees, that the central wood is undergoing alteration, and the tree passing to decay. When the bark separates from the wood, or when it is divided by separations which pass across it, the tree is in a considerable state of degradation. When the bark is loaded with moss, lichen, or fungi, or is marked with black or red spots, these signs of alteration in the bark justify suspicions of alterations in the wood within. When sap is seen to flow from clefts in the bark, it is a sign that the trees will soon die. As to wounds or gutterings, these defects may arise from local causes, and are not necessarily the result of old age.

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## *Method of reviving Plants, Shoots, Sprigs, Slips, and other Vegetables.*

This is called a proved method of reviving plants, &c. when their leaves and buds are faded, and their bark and roots hard and nearly dry, by M. de Droste, of Hülshof. The directions are to dissolve camphor to saturation in alcohol, adding the former until it remains solid at the bottom of the latter; a sufficient quantity of rain or river water is then to have the alcoholic solution added to it, in the proportion of four drops to one ounce of water. As the camphor comes in contact with the water, it will form a thin solid film, which is to be well beaten up with the water: for a short time the camphor will float in the water in small flocculi, but will ultimately combine with the fluid, and disappear.

Plants which have been removed from the earth, and have suffered by a journey or otherwise, should be plunged into this camphorated water, so that they may be entirely covered: in about two, or at most three hours, the contracted leaves will expand again; the young, faded, and dependant shoots will erect themselves, and the dried bark will become smooth and full. That being effected, the plant

is to be placed in good earth, copiously watered with rain or river water, and protected from the too powerful action of the sun, until the roots have taken good hold of the ground.

When large plants, as trees, are to be revived, their roots are to be plunged into the camphorated water for three hours; the trunk, and even the head, of the tree being frequently wetted with the same water, so as to retain them in a properly moistened state. But it is always best, if possible, to immerse the whole of the plant. Shoots, sprigs, slips, and roots, are to be treated in a similar manner.

If plants thus treated are not restored in four hours, their death may be considered as certain, for they cannot be recalled to life by any artificial means. They should, consequently, never be left more than four hours in the camphorated bath; because the exciting action of the camphor, when it is continued for a longer period, may injure the plants instead of doing good to them. It is not necessary to say that the final prosperity of the plants, thus re-animated by the camphorated water, must depend upon the particular properties of the former, the state of their roots, and the pains that are taken with them. The camphor produces no other effect than to restore life to plants nearly dead: after that, all proceeds according to the ordinary laws, and their ultimate state must be left to art and nature.

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## *Account of the Diamond Workings and Diamonds of Sumbhulpore.*

*By* Peter Breton, Esq., *Surgeon, Superintendent of the School of Native Doctors at Calcutta.**

The districts of Chota, Magpore, and Sirgoojah are not marked for their mineral productions; but Sumbhulpore† has been, from time immemorial, distinguished for its production of the finest oriental diamonds in the known world. They are occasionally found in the bed of the Mahanuddee, and at the mouths of other rivers which terminate in it. The following is an extract from the observations of a gentleman, whose source of information on this interesting subject was the best that could be obtained in Sumbhulpore:—

The Mahanuddee is navigable for six months in the year, though not without obstructions and difficulties, for boats of three to four hundred maund's barthen, from the sea to Sooreenarain, which cannot be less than three hundred and eighty miles; and for smaller vessels as far as Sumbhulpore, for ten months. Diamonds of various sizes, and of the first quality, are occasionally found at the mouths of the rivers Maund, Keloo, Eeb, and others, which all have their sources in the mountainous parts of Koorba, Sirgoojah, Raegurh, Jushpoor, and Gangpoor, and fall into the Mahanuddee on its left bank. They are also picked up, after the termination of the rains,

* This curious paper is abridged from the *Transactions of the Medical and Physical Society of Calcutta.*

† The valley of Sumbhulpore is four hundred and ten feet above the sea.

amongst the mud and sand deposited on the beds of islands on the left bank, (where the stream, being resisted, makes a sharp turn,) by persons of a peculiar class, whose occupation it is to search for them. I cannot learn that diamonds have ever been found on the right bank of the Mahanuddee, or on the left bank above its confluence with the Maund at Chunderpore, or below Sonepoor. It would appear, therefore, that they were washed down from the sides of the streams which flow from north to south through the mountainous and almost inaccessible track which occupies, in Arrowsmith's Map, the 83d and 84th degrees of east longitude, and 21st and 22d degrees of north latitude. This inference is further supported by the fact of their being not unfrequently met with in the beds of Nullahs in Raegurh, Jushpore, and Gangpoor, though I have no reason to think that any attempt has been ever made to discover and open their mines or beds; and this may be chiefly accounted for by the state of society and government in these wild regions. Any attempt on the part of a private individual to appropriate to himself, or conceal a diamond, would, if discovered, have been assuredly punished with death; and the rajahs have mutually preferred this scanty and uncertain acquisition of precious stones in the manner I have described, to the publicity and consequent interference of the Mahomedan or Marhatta sovereigns, by whom they were in turn ruled, which would necessarily have resulted from the establishment and working of mines. Another obstacle has doubtless been the extreme insalubrity of the climate of the tract under consideration—an insalubrity which the observation of many years has convinced me always attached to mountainous and woody districts, in which gold and diamonds are indigenous. None but natives of the wilds, whose appearance sufficiently marks the ravages of disease, can enter them with impunity, excepting in January and the three succeeding months, and this would form the chief objection to the employment of skilful European mineralogists, whose researches, if they could be adequately persevered in, would, I am sanguinely of opinion, be attended with very interesting and important results.

There were two tribes or castes of diamond searchers in Sumbhulpore, of whose origin, or of the period of their settlement in this part of the world, I can learn nothing. They have the appearance, however, of aborigines. The names of the tribes are Ihara and Tora. Sixteen villages of the poorer description have been always enjoyed by them in rent-free Jageers; of these, four are in the hands of the Toras, ten possessed by the Iharas, and two have been given to their tutelar deity Bukeser Pat, an appellation of Mahadeo. They are under the direction of three chiefs, or Sirdars, two of the Ihara tribe, called Pater and Buhera, and one of the Tora, styled Seeree Ghakur. They search for gold as well as diamonds, and are allowed to dispose of all the former article they pick up. Their habits are extremely dissipated; and when they find a diamond they spend the money it procures for them in a continued scene of debauchery. In the Pergunnahs of Raegurh, Sonepoor, Jushpoor, and Gangpoor, are also to be found persons of this kind. In the two last-mentioned a species

of gold mine is to be found, the aperture only just large enough for a man to descend, but of considerable extent below. An account of the mine in Gangpoor, from which it is stated to me that a species of pure gold of considerable size has been obtained, remains to be submitted.

The diamond-searchers, with their women and children, amounting to between four and five hundred persons, are annually employed from the month of November till the commencement of the rainy season in searching the bed of the Mahanuddee for diamonds. They examine such parts of the river as are obstructed by rocks from Chunderpoor to Sonepoor, a distance of about one hundred and twenty miles, and all the hollows in the bed of the Mahanuddee in which alluvial matter is deposited. The process pursued by the searchers is extremely simple, and three implements only are used by them. The first is a kind of pick-axe with one pick, called Ankooa; the second, a plank of about five feet in length, and two feet in width, made a little concave towards the centre, and a rim of three inches in height on each side, called Doer; and third, a board of similar form, but only half the size of the former, called Kootla. With the pick-axe the earth is dug out of the hollows, and collected in heaps near the stream: pieces of this earth are then placed by the women on the large board, which is so inclined as to allow the earth, when mixed with water, gradually to run off; the pebbles and coarse gravel are then picked and thrown away, and the remaining mass is afterwards removed from the large to the small board, and spread over the latter, to admit of every particle being minutely examined, and gems and grains of gold, if any be present, being collected. The earth in which the diamond is usually found consists of a mixture of stiff reddish clay, pebbles, and a small proportion of sand and a little oxide of iron. This earth the searchers take particular pains to find, and they examine every particle of it with the greatest attention.

Although employed exclusively in this occupation from time immemorial, the Iharas have not the remotest idea of what constitutes the matrix of the diamond. Mr. Mawe, in his *Account of the Diamonds of Brazil*, states, that "the only places where diamonds have certainly been found in modern times are the central and southern parts of India Proper, the peninsula of Malacca, the Island of Borneo, and the mountainous district called Serro Do Frio, and other places in Brazil. Neither the rock in which it occurs, nor the other minerals with which it is accompanied in Malacca and in Borneo, are at all known. In India it is found in detached crystals, in a kind of indurated, ochrey gravel; but whether or not this is its native repository is uncertain."

The diamonds of Brazil, like those of India, are found in a loose gravel-like substance, immediately incumbent on the solid rock, and covered by vegetable mould and recent alluvial matter. This gravel consists principally of rounded quartz, pebbles of various sizes mixed with sand and oxide of iron, and enclosing rounded topazes, blue, yellow, and white, and grains of gold. In some parts of the diamond territory of Serro do Frio, which I visited, the gravel is cement-

ed, by means of the oxide of iron, into a considerably hard conglomerate, forming rocks and low hills. On the sides of these are water-courses, produced by the torrents during the rainy season, the beds of which are very unequal and excavated. In these hollows diamonds are not unfrequently discovered. The usual and regular method of searching for diamonds is to collect the disintegrated conglomerate in which they are found at the bottoms of rivers and of ravines, and by a laborious process of washing, as long as the water comes off discoloured, to separate the mud from the distinct grains. The residue, thus cleaned, is subjected to an accurate examination for the diamonds which it may contain. These are distinguished partly by their crystalline form, but principally by their peculiar lustre, slightly verging on semi-metallic, but which cannot be adequately described by words.

If the above-mentioned conglomerate be not the real matrix of the diamond, its true geological situation is unknown, for it has never as yet been discovered in any other rock.

Now, although the Sumbhulpore diamond is more frequently found in the red earth above described, yet it is now and then met with in other kinds of compositions. The proof of this red conglomerate being its matrix is by no means established. In the late Dr. Voysey's *Description of the Diamond Mines in Southern India*, it is stated that the only rock in which the diamond is found is the sandstone breccia.

In the reign of the former rajahs and ranees in Sumbhulpore, the right to all diamonds found in the bed of the Mahanuddee was established, and on a diamond of magnitude being found by the Iharas, the finder was rewarded by a grant of a small village in Jageer, and by presents in money and clothes. When detected in secreting a diamond, they were punished with death, or by being severely beaten and deprived of their Jageers, and of the privilege of again searching for diamonds.

The facility with which a diamond, when found by the Iharas, can be secreted, (for, instead of vigilance being exercised over them, they are left to use their own discretion in searching for this gem,) and the extreme difficulty in detecting the fraud, render it more than probable that many very valuable diamonds are at this moment in the possession of the finders, which they are afraid to disclose. For, in 1818, on the power of the British government being established in Sumbhulpore, a diamond which had been secreted, by the searchers, from the former rulers of Sumbhulpore, was actually brought and delivered to the late political agent, and by him sent to government as a part of the property of Sumbhulpore, which, by right of conquest, became the property of the state. It weighed eighty-four grains, and was valued at five thousand rupees.

At Sumbhulpore the quality of the diamond is named after the four tribes of the Hindoos. A diamond of the first quality is called Brahmin; the second is named Chetree; the third Bysh; and the fourth Soudra; and, from experience, the native jewellers judge pretty accurately of their respective qualities. The weights they employ for weighing the diamond are the ruttee and masha; the former is a frac-

tion less than two grains troy weight, and seven ruttees make a masha. Rough diamonds are estimated according to their quality. The first quality is valued at, per masha, 500 sicca rupees; second at 400 sicca rupees; third at 300; and fourth at from 175 to 200 sicca rupees per masha. This mode of valuing a rough diamond is somewhat different from the rule laid down by Jeffries for ascertaining the value of this gem in its native state. According to Jeffries, the carat weight of a rough diamond is squared, and then multiplied by 2, and the product is the value of the gem in pounds sterling. For example, a diamond of 20 carat weight, $20 \times 20 = 400 \times 2 =$ £800 sterling. If the product of the square of the carat weight of a cut diamond be multiplied by 4 instead of 2, its total will be the value of a cut diamond in pounds sterling. This rule applies only to diamonds of small weight, for the value of a diamond of magnitude increases, without any established rule, rapidly with its size.

The large diamond found in 1809 was of the third (Byshes) quality. It was picked up in the month of October, at a place called Herakode, in the bed of the Mahanuddee; and its delivery to Ranee Ruttun Coher was unluckily delayed on account of her being engaged in performing the funeral ceremonies of her husband's mother; and before they were finished, the Marhatta troops arrived and expelled her from the country. A traitorous servant of her's betrayed the secret of the valuable stone to Chunderjee Bhoonsla, the commanding officer, who persuaded the diamond-finders to surrender it to him by promises of the grant of a fine village and a thousand rupees. On the following morning, when they appeared to claim performance, they were reproached for bringing a stone instead of a diamond, and driven from his presence.

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## *French Building Regulations.*

The dreadful accident that has occured at the Brunswick Theatre, and the insecurity of the public, from the ignorance or negligence of individuals, calls imperiously for some legislative regulations similar to those adopted by the French government. In France, details of every part of the plan and construction of the public buildings must be previously submitted to a government architect, who examines the whole carefully, and suggests the alterations and modifications which he judges necessary for the public safety: and it is only on his written approval of the plan that the construction is permitted to be executed. Nor does his charge end here; he superintends the works as they proceed, and prevents the slightest deviation from the plan as sanctioned by him. Had such a regulation existed in England, the calamity at the Brunswick Theatre would not have happened.

The paternal care of the French government, in whatever concerns the public safety and health, is admirable. In England, we

hear continually of houses in a state of dilapidation falling, and entombing numerous persons in the ruins. In France there are regular inspectors, who go systematically through Paris, to ascertain the state of the houses; and whenever the slightest appearance of danger is obvious, the tenants are ordered to quit, and the place is pulled down. Private interests are never consulted, when the personal safety of the public is concerned. This *surveillance* is extended to the construction of all forges, furnaces, steam-engines, the manufactories of chemical products emitting offensive odours, &c. If a high-pressure engine be permitted in a town, one of the conditions is, that it shall be surrounded by a wall four feet thick; and the chimney must rise to a certain height above the adjoining buildings. The engine is not even permitted to be wrought, unless the boiler has been previously proved capable of supporting a power of steam four times greater than that at which it is intended to work. Besides these precautions, every boiler must be provided with a metallic plate, fusible at a small degree above the working power, that in case the safety valve should not act, or any other dangerous circumstance arise whereby the steam would become of a greater force than intended, the plate may melt, and the steam escape in abundance by the orifice. A few months since, a dyer, near Paris, who had a high-pressure engine, was interdicted working it, on account of the insecurity of the boiler. The proprietor ordered another to be made, and invited the officers of government to witness the proof of it at the maker's: it was intended to work at two atmospheres, and perfectly resisted the force of eight atmospheres; and was, consequently, approved. The proprietor, however, thinking to be too cunning, did not send for it, but had his old boiler cut shorter and used again. The government engineers, not suspecting the trick, did not examine the boiler when putting up. The engine had not been at work two hours, when the new end of the boiler was blown off at the rivets; the steam rushed out, and destroyed two houses in the rear; and the boiler itself was driven in a contrary direction, through the engine-house, to the distance of sixty yards; though weighing above two tons: it destroyed the engine, and killed the engineer and the proprietor, who happened to be in the engine-house. This accident arising from the wilful misconduct of the proprietor, his family was ordered to grant a pension to the widow of the engineer.

[*Literary Gazette.*

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## *History of the Telegraph.*

The telegraph, though it has been generally known and used by the moderns only for a few years, is by no means a modern invention. There is reason to believe, that amongst the Greeks there was some sort of telegraph in use. The burning of Troy was certainly known in Greece very soon after it happened, and before any person had returned from thence. Now that was altogether so

tedious a piece of business, that conjecture never could have supplied the place of information. A Greek play begins with a scene, in which a watchman descends from the top of a tower in Greece, and gives the information that Troy was taken. "I have been looking out these ten years," says he, "to see when that would happen, and this night it is done." Of the antiquity of a mode of conveying intelligence quickly, to a great distance, this is certainly a proof.

The Chinese, when they send couriers on the great canal, or when any great man travels there, make signals by fire from one day's journey to another, to have every thing prepared; and most of the barbarous nations used formerly to give the alarm of war by fires lighted on the hills or rising grounds.

Polybius calls the different instruments used by the ancients for communicating information πυρσοι, *pyrsiæ*, because the signals were always made by means of fire. At first they communicated information of events merely by torches; but this method was of little use, because it was necessary beforehand to fix the meaning of every particular signal. Now, as events are exceedingly various, it was impossible to express the greater number of them by any premeditated contrivance. It was easy, for instance, to express by signals that a fleet had arrived at such a place, because this had been foreseen, and signals accordingly had been agreed upon to denote it; but an unexpected revolt, a murder, and such accidents as happen but too often, and require an immediate remedy, could not be communicated by such signals; because to foresee them was impossible.

A new method was invented by Cleoxenus, (others say by Democritus,) and very much improved by Polybius, as he himself informs us. He describes this method as follows:—Take the letters of the (Greek) alphabet, and divide them into five parts, each of which will consist of five letters, except the last division, which will have only four. Let these be fixed on a board in five columns. The man who is to give the signals is then to begin by holding up two torches, which he is to keep aloft till the other party has also shown two. This is only to show that both sides are ready. These first torches are then withdrawn. Both parties are provided with boards, on which the letters are disposed as formerly described. The person, then, who gives the signal is to hold up torches on the left, to point out to the other party from what column he shall take the letters as they are pointed out to him. If it is to be from the first column, he holds up one torch; if from the second, two; and so on for the others. He is then to hold up torches on the right, to denote the particular letter of the column that is to be taken. All this must have been agreed on beforehand. The man who gives the signals must have an instrument, (διοπτρα,) consisting of two tubes, and so placed as that, by looking through one of them, he can see only the right side, and through the other only the left, of him who is to answer. The board must be set up near this instrument; and the station on the right and left must be surrounded with a wall, (παρατειφαχθαι,) ten feet broad, and about the height of a man, that the torches raised above it may give a clear and strong light, and that when taken down they may

be completely concealed. Let us now suppose that this information is to be communicated—*A number of the auxiliaries, about a hundred, have gone over to the enemy.* In the first place, words must be chosen that will convey the information in the fewest letters possible; as, *A hundred Cretans have deserted,* Κρητες εκατον αφ' ημων αυτομολησαν. Having written down this sentence, it is conveyed in this manner:—the first letter is a K, which is in the second column; two torches are therefore to be raised on the left hand, to inform the person who receives the signals to look into that particular column. Then five torches are to be held up on the right, to mark the letter *k*, which is the left in the column. Then four torches are to be held up on the left to point out the ε (*r*), which is in the fourth column, and two on the right, to show that it is the second letter of that column. The other letters are pointed out in the same manner. Such was the *pyrsia*, or telegraph, recommended by Polybius.—See Polyb. lib. x. ext. 7. cap. 2.

But neither this, nor any other method mentioned by the ancients, seems ever to have been brought into general use; nor does it appear that the moderns had thought of such a machine as a telegraph till the year 1663, when the Marquis of Worcester, in his *Century of Inventions*, affirmed that he had discovered "a method by which, at a window, as far as the eye can discover black from white, a man may hold discourse with his correspondent, without noise made or notice taken; being according to occasion given, or means afforded; *ex re nata*, and no need of provision beforehand; though much better if foreseen, and course taken by mutual consent of parties." This could be done only by means of a telegraph, which in the next sentence is declared to have been rendered so perfect, that by means of it the correspondence could be carried on "by night as well as by day, though as dark as pitch is black."

Dr. Hooke, whose genius as a mechanical inventor was, perhaps, never surpassed, delivered a "Discourse to the Royal Society, May 1684, showing a way how to communicate one's mind at great distances." It was not, however, till the French Revolution, that the telegraph was applied to useful purposes. Whether M. Chappe, who is said to have invented the telegraph first used by the French about the end of 1793, knew any thing of Hooke's or of Amonton's invention, it is impossible to say; but his telegraph was constructed on principles nearly similar. The manner of using this telegraph was as follows:—At the first station, which was on the roof of the palace of the Louvre, at Paris, M. Chappe, the inventor, received in writing, from the Committee of Public Welfare, the words to be sent to Lisle, near which the French army at that time was. An upright post was erected on the Louvre, at the top of which were two transverse arms, moveable in all directions by a single piece of mechanism, and with inconceivable rapidity. He invented a number of positions for these arms, which stood as signs for the letters of the alphabet; and these, for the greater celerity and simplicity, he reduced in number as much as possible. The grammarian will easily conceive that sixteen signs may amply supply all the letters

of the alphabet, since some letters may be omitted, not only without detriment, but with advantage. These signs, as they were arbitrary, could be changed every week; so that the sign of n for one day might be the sign of м the next; and it was only necessary that the persons at the extremities should know the key. The intermediate operators were only instructed generally in these sixteen signals, which were so distinct, so marked, so different the one from the other, that they were easily remembered. The construction of the machine was such, that each signal was uniformly given in precisely the same manner at all times; it did not depend on the operator's manual skill; and the position of the arm could never, for any one signal, be a degree higher or a degree lower, its movement being regulated mechanically.

M. Chappe, having received at the Louvre the sentence to be conveyed, gave a known signal to the second station, which was Mont Martre, to prepare. At each station there was a watch-tower, where telescopes were fixed, and the person on watch gave the signal of preparation which he had received, and this communicated successively through all the line, which brought them all into a state of readiness. The person at Mont Martre then received, letter by letter, the sentence from the Louvre, which he repeated with his own machine: and this was again repeated from the next height, with inconceivable rapidity, to the final station at Lisle.

The first description of the telegraph was brought from Paris to Frankfort on the Maine by a former member of the parliament of Bourdeaux, who had seen that which was erected on the mountain of Belville.

Two working models of this instrument were executed at Frankfort, and sent by Mr. W. Playfair to the Duke of York; and hence the plan and alphabet of the machine came to England.—Various experiments were in consequence tried upon telegraphs in this country; and one was soon after set up by government, in a chain of stations from the Admiralty-Office to the sea-coast.

Telegraphs have now been brought to so great a degree of perfection, that they convey information speedily and distinctly, and are so much simplified, that they can be constructed and maintained at little expense. The advantages, too, which result from their use are almost inconceivable. Not to speak of the speed with which information is communicated and orders given in time of war, by means of them, the whole kingdom could be prepared in an instant to oppose an invading enemy. A telegraph might also be used by commercial men, to convey a commission, cheaper and speedier than an express can travel. An establishment of telegraphs might be made like that of the post; and instead of being an expense, it would produce a revenue. Something of this kind was, about twenty years ago, set up to facilitate the intercourse between Norwich and Yarmouth; and a new and extensive plan of the same kind was lately in agitation.—*Gregory's Mechanics.*

FOR THE FRANKLIN JOURNAL.

*On the combination of a Practical with a Liberal course of Education. By* W. R. Johnson, *Principal of the High School of the Franklin Institute.*

In the present state of public feeling with regard to education, no apology will be required for an attempt to aid its advancement. A constantly increasing interest in the subject, forbids us to suppose that the science and practice of instruction, can remain stationary, while other arts and sciences are advancing. Pursue what other trade or profession we may, the art of developing mind cannot be neglected. We owe it to conscience,—to patriotism,—to humanity,—to posterity, that the generation now rising to enjoy the blessings, and sustain the responsibilities, of civil and religious liberty, should not be left to grope in the darkness of ignorance, and thus to disgrace the institutions which their fathers have founded. Indeed, a conviction, that all the substantial interests of society are dependent on the diffusion of learning, is rapidly pervading every class of American citizens.

Aware that no advantages of soil, of climate, of commercial facilities, of wealth acquired, or wealth transmitted, can compensate for a deficiency of moral and intellectual culture, they are, with different degrees of zeal, endeavouring to establish and improve their systems of universal education. The *industrious* are sure of profit, and the *independent* of pleasure, from the same source. The private citizen finds his highest happiness in refined and polished society. The statesman feels it to be his greatest glory to make and administer laws among a people of whom every individual can appreciate his merits. In such a community, wealth confers no privilege but that of being foremost in acts of beneficence, and poverty will neither be offered nor received as an apology for acts of knavery and duplicity.

Would a town, city, or state, possess weight in the scale of public estimation? it must be derived, mainly, from the spirit which presides over public instruction. Wealth cannot purchase the desired influence. Arrogant pretensions will never be long accepted in place of *real* intellectual worth.

A few great men, may, it is true, do much towards conferring respectability on their state, or district; but unless they move amidst men of similar character, they serve, like the columns at Persepolis, only to make the surrounding desolation more frightful. It does not particularly delight the eye of a republican to behold a few pyramids and palaces, amidst a million of hovels; and how can it be more consonant with his feelings, to contemplate ignorance, vice, and wretchedness, yielding a blind homage to that greatness, which, perhaps, becomes apparent, only by a comparison with what is absolutely mean and diminutive.

The republic claims a right to all the effective talent which can

possibly be elicited, from among every class of her sons, and which can aid to sustain the dignity and consistency of her character.

Nor are we without *external* motives for sustaining the cause of universal education. Distant nations look to America, to set the example of abolishing those odious *monopolies* in learning, which have for ages closed the career of generous competition against ninety-nine hundredths of mankind. The feudal times saw learning, as they saw wealth and titles, entrenched behind barriers which it was profanation for any but the privileged orders to approach.

To impose more effectually on a half enlightened age, learning assumed her costly trappings, her pomp and circumstance, her sounding titles, and a certain supercilious behaviour.

The scholastic wisdom of those times consisted, in a great measure, of a kind of knowledge, for which common men could have no manner of use, and which was often but a mere matter of pride to its actual possessor. It is justly expected of *America*, that she will banish the childish follies of learning, and retain only its wisdom; that keeping pace with the improvements of the age, she will apply the excellencies of every method, the useful parts of every system, in the construction of that which is intended to diffuse the highest degrees of usefulness and happiness.

Leaving the politicians to wrangle about the "*American system*" of internal policy, we may venture to lay down some principles for the formation of a *republican system of education*, such as reason demands, and experience has already justified. On this subject we may reasonably anticipate that the nation will form but one party. As all are satisfied that republican government, is, in itself, a blessing; and not only abstractly good, but *practically* better than any of the forms of European despotism, whether absolute or limited; so all should unite to establish and foster a system of education, consistent with the character of a self-governed people.

Such a system must be founded on the principle of equal rights, and equal obligations;—equal rights in those who are to be educated, and equal obligations on those who are to furnish the pecuniary means. To realize this principle in its full extent, *public* institutions, adequate to the wants of every class in society, must be established in every part of our country.

In defect of such institutions, those seminaries which are established by societies, or individuals, ought to approach as near as possible to the character of public schools, both in the liberality of their terms, the wide extension of their advantages, and their subjection to the influence of public opinion. Differences between parents, in respect to fortune, trade, profession, religious sect, or political party, ought to make no difference in the kind or degree of early instruction offered to their children.—Economy of *time* and *money* is a primary requisite in every system of education intended for general adoption. Every device which can aid the attainment of this desirable end, must therefore be introduced.—In the business of teaching, the greatest division of labour which is consistent with strict economy, ought to prevail.—To promote economy, to excite emulation, to give each student an opportunity to compare himself with many

others, and by a strict classification according to advancement, to prevent the retardation of one, through the dulness of another, a school must be more numerous than could be conveniently instructed by a single individual, and must be provided with a greater or less number of teachers, according to the greater or less number of branches to be embraced, and to the higher or lower rank which it is to hold in the scale of institutions.—The greatest practical subdivision of classes is desirable.—Its methods of instructing and governing ought to embrace whatever is most efficient and useful in all the systems of education which have been promulgated.—Self improvement by active exertion is ever to be preferred to the passive reception of knowledge from others. Hence the strongest incitements to *voluntary* study should be offered to the students.

The foregoing are a few of the leading maxims which were followed in the formation of an institution connected with the Franklin Institute, and of which it is proposed to give hereafter a rather more detailed account, than has yet appeared.

The following remarks extracted from an address of the Committee of instruction, published at the time of opening the establishment, further illustrate its design.

"In forming this school, it was the aim of the board, to give to the sons of tradesmen, and other citizens in moderate circumstances, the same advantages of education, which have heretofore been almost exclusively enjoyed by the children of the rich. In this country, where permanent distinctions of rank are inconsistent with the spirit of our republican institutions, it is impossible to tell, from the situation of the parent, what may be the destiny of the child. The board have therefore selected a course of studies, such as experience has proved to be the most useful for the advancement of the pupil in future life, and such as is universally selected by the enlightened parent, whose wealth enables him to make a choice for his son. Against the adoption of such a system, the only rational objection that can be urged, is the expense of time and money which it generally involves. But the modern improvements in education, and particularly the plan of monitorial or mutual instruction which is introduced into the High School, have nearly removed these difficulties."

It is proposed to give, in a few essays, an exposition, as brief as the subject will admit, of the course of study, system of instruction, practical results of the different methods of teaching, and of such other points as have constituted the subjects of frequent inquiry with those persons who have applied for information respecting the institution above mentioned.

*Observations on the Phenomenon observed by* M. Clement, *in the emission of Steam, and on an analogous effect in the attempt to separate two flat disks by a current of air.*

Much interest was excited by the phenomenon first observed by M. Clement, of Paris, an account of which will be found in vol. 4, p. 97 of this Journal; and also some remarks thereon, by Mr. Perkins, at p. 252 of the same volume. A similar phenomenon has since engaged the attention of the curious, the apparatus for exhibiting which is so extremely simple that every one can try the experiment for himself. Take two disks of card about the size of a dollar, perforate one of them in the centre, so that a tube may fit it; a common quill answers the purpose perfectly well; if these disks be placed upon each other, wind may be blown through the tube without separating the disks, or if one of them be placed on a table, it may be raised up by causing the perforated disk to approach it, and blowing through the tube.

Of this phenomenon Professor Hare has published a rationale; and we have received two others from correspondents, the whole of which we now publish, presenting them in the order in which they have been written. Editor.

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*Rationale, of the difficulty, in certain cases, of separating plane surfaces by a blast. By* R. Hare, M. D., *Professor of Chemistry in the University of Pennsylvania.*

The phenomenon above alluded to, is usually illustrated by means of two disks, into the centre of one of which a tube is fastened, so that on blowing through the tube the current is arrested by the moveable disk. Under these circumstances the moveable disk is not removed, as would be naturally expected.

Supposing the diameter of the disks to be to that of the orifice as 8 to 1, the area of the former to the latter must be as 64 to 1. Hence if the disks were to be separated (their surfaces remaining parallel) with a velocity as great as that of the blast, a column of air must meanwhile be interposed, 64 times greater than that which would escape from the tube during the interim. Consequently, if all the air necessary to preserve the equilibrium be supplied from the tube, the disks must be separated with a velocity as much less than that of the blast, as the column required between them is greater than that yielded by the tube, and yet the air cannot be supplied from any other source, unless a deficit of pressure be created between the disks unfavourable to their separation.

It follows then, that under the circumstances in question, the disks cannot be made to move asunder with a velocity greater than 1-64th of that of the blast. Of course, all the momentum of the aerial particles which constitute the current through the tube will be expended on the moveable disk, and the thin ring of air which exists

around the orifice between the disks; and since the moveable disk can only move with 1-64th of the velocity of the blast, the ring of air in the interstice must experience nearly all the momentum of the jet, and must be driven outwards, the blast following it in various currents, radiating from the common centre of the tube and disks. The effect of such currents in producing an afflux of the adjoining portions of any fluid in which they may be excited, is well known, having been successfully illustrated by Venturi. See Nicholson's Journal, quarto, vol. 2nd, p. 172.

Accordingly the afflux of the air towards the disks counteracts the small velocity which the blast would communicate, and thus prevents their separation, and may even cause them to approach each other, if previously situated a small distance apart.

This rationale commences with the assumption that the disks will remain nearly parallel. That there cannot be much deviation from parallelism must be evident, since any obliquity will make the opening greater on one side than on the other; and the jet proceeding with most force towards the widest opening, will increase the afflux of air upon the outer surface of the moveable disk in the part where the current is strongest, and thus correct the obliquity. [*Chronicle.*

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*An inquiry into the cause of the adhesion of disks, when an attempt is made to separate them by a current of air. By* James P. Espy, *Professor of Languages.*

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Philadelphia, June 20th, 1828.

Dear Sir,—The subjoined explanation of the phenomenon to which it relates was given by me to a gentleman of this city, in reply to a communication from him, and may probably be deemed worthy a place in your Journal.

Yours, &c.

James P. Espy.

If you take two disks of common playing cards, about two inches in diameter, or even less, and insert the end of a small tube into a hole made in the centre of one of them, and lay the other on the top, and cause a current of air to pass through the tube with moderate velocity, the upper card will not be removed, but will be pressed towards the other card with considerable force; a force sufficient to support its weight, when the experiment is performed with the cards reversed, and the current of air made to pass downwards.

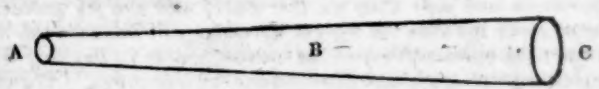
The only explanation of this remarkable phenomenon, that I have seen, which has any plausibility, is that of Professor Hare, which you had the kindness to send me. The direct force of the current at the centre of the disks is correctly estimated, and is, indeed, very small, where a free passage is given to the air laterally; but the counteracting force assigned by the Professor is, if it exists at all, hardly appreciable, and is therefore not the true cause of the phenomenon.

The following I consider as the *experimentum crucis* to disprove Professor Hare's theory. I placed a disk of card on a table, and applied the other disk with the tube attached, near the one on the table, and blew downward: the current of air could not be produced so as to strike against the lower side of the disk on the table, yet the disk rose, in opposition to the current through the tube.

The true theory I believe to be, that during the passage of a current of air through the tube, and between the disks, there is less air between the cards in a given space than when the air is at rest, and, of course, the pressure on the inside is diminished, while that on the outside remains the same.

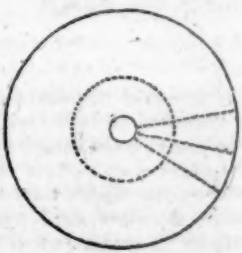
Let us see if this assertion can be established from principles known and acknowledged by all philosophers.

Let A, B, C, be a tube, widening from A to C. Suppose air to be forced in at A, under a double condensation, sufficient to carry it from A to B in a second.




It is manifest, from the nature of inertia alone, it will incline to move with a uniform velocity through the whole length of the tube; but in consequence of the elasticity of the air, the velocity will be increased, until it arrives at a part of the tube sufficiently increased in area to permit the density in the inside to be equal to that of the atmosphere; after *that* the velocity, from inertia, inclines to continue the same; but, as the tube becomes wider, it cannot do this without becoming rarer than atmospheric air, which actually takes place in its passage through the remainder of the tube.

Now, what has been said of the tube A B C, may be applied to the phenomenon in question.



Suppose the annexed figure represents the interior of the two disks, the whole of that space may be conceived as consisting of innumerable tubes widening from the centre to the circumference. After the air is turned into these tubes, which is done, as Professor Hare shows, with a very small force, the reasoning used above concerning a single tube will apply to the whole area of the cards; the air will increase in velocity by the *vis a tergo*, as long as it is denser than the atmosphere; but as soon as it arrives at a part of the disks where the area is sufficiently enlarged, (suppose at the inner circle,) to permit the air to expand to an equal density with the atmosphere, the *vis a tergo* ceases, and it is urged forward with the last acquired velocity, retarded, it is true, by the atmosphere, but not so much so as to prevent it from expanding, and thus becoming rarer than atmospheric air.

How much rarer than the atmosphere the air will be between the two circles, will depend on the degree of condensation in the tube, and if the air is only moderately condensed it will be nearly as much rarer between the circles as it is denser within the inner circle. With regard to the distance from the centre where the air becomes of equal density with the atmosphere, it will depend on the shape of the hollow; but as the experiment is generally performed, it will not be much more than double the diameter of the tube.

Now, as the air, which is denser than the atmosphere, occupies but a small portion of the area of the disks around the centre, and a much larger portion of it is occupied by air which is lighter than the atmosphere, the disks will be pressed together with the difference of these forces, minus the direct impulse of the air in front of the tube, whilst it is turning at right angles to its course in the tube.

Perhaps it may be objected to this hypothesis, that the resistance of the atmosphere to the egress of the air from between the disks, will prevent the air from becoming rarer than the atmospheric air at rest.

To this I answer, that I have lately ascertained by some experiments in hydraulics, (which I shall publish before long,) that as much water runs out in a given time through a hole in the side of a vessel containing water under a given head, when the egress is made below the surface of water, as when made in the open air. If then water, which is nearly 800 times denser than the atmosphere, makes no more resistance to the efflux of water than the air does, may we not reasonably infer, that, in very short tubes at least, the atmosphere makes no sensible resistance to the egress of a current of air? Indeed, I intend to show from theory, that some tubes will discharge more water in the atmosphere than in vacuo.

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*On the difficulty of separating flat disks by a current of air, or of steam, when their surfaces are in contact, or nearly so.* *By* ASA SPENCER, *Mechanician.*

TO THE EDITOR OF THE FRANKLIN JOURNAL.

SIR,—Agreeably to my promise, I offer for insertion in your Journal, my theory respecting the adhesion of disks, which I shall be pleased to see published, should it meet your views.

Yours, &c.

ASA SPENCER.

In the Journal of the Franklin Institute of last year, was published a communication by M. CLEMENT of the following purport.

A flat valve being placed over an orifice in a steam chest, and covering a considerable space around the orifice, when the steam was let on, the valve, instead of rising, as was expected, kept its place, and required a considerable additional force to lift it.

To this phenomenon I offered the following explanation to some of my scientific friends, who thought it satisfactory.

The extent of the valve, we will suppose to equal four square inches,

its surface flat, and placed on the steam chest, where the surface is also flat. We will also suppose a space between the surfaces, sufficient to admit the atmosphere, it is evident that the top and bottom of the valve will be then equally pressed by it, and in that state the valve may be lifted with a force only sufficient to overcome its gravity.

Suppose an opening to be now made in the chest, under the centre of the valve, equal to one square inch, or one-fourth the size of the valve, the steam being then let into the chest with a power of thirty pounds to the inch, this rushes against, and communicates the same power to the one inch of the valve immediately over the aperture, which being only about half the force of the atmosphere on the whole 4 inches on the top of the valve, it cannot rise with any thing like the velocity with which the steam would move: its current, therefore, must necessarily be checked. Now currents of fluids on meeting an immoveable obstacle are not reflected back, like solids, but take a direction parallel to the surface against which they strike: currents of fluids also, whether elastic or nonelastic, exert no force, but in the direction in which they move; the latter is fully proved by forcing air, or water, through a cylindrical tube, if holes be made in the sides of the tube none of the fluid will escape.

It follows, then, that the steam on striking against the valve, as above mentioned, and thus arrested in its course, which was perpendicular to the valve, takes one parallel to it, and rushes out in all directions, in radii from the centre; of course, the atmosphere between the disks is driven out, leaving nothing between but steam, and that exerting no force on the valve except on the one inch in the centre, its course over the remaining surface is parallel to it, and its force is exerted only in that direction.

The state of the valve would then be as follows; pressed upwards by steam of 30 pounds to the inch, acting on the one inch only at the bottom, and pressed downward by the weight of the atmosphere of 15 pounds to the inch, acting on the whole four inches at top; making the downward, double that of the upward pressure.

The above will appear pretty evident, by the following experiment: take two thin flat plates of metal, tin plate for example, about three inches diameter, in the centre of one insert a tube several inches long, and about $\frac{1}{8}$ of an inch in diameter perpendicular to its planes; let both plates be pierced full of holes except near their centres; let these plates be placed with their surfaces parallel to each other, and about $\frac{1}{16}$ of an inch apart, and attach the tube to a cock under a considerable head of water; when the water is let on it passes by the tube through the first plate, and on being checked by the second plate, passes out between them in a thin and even sheet, while none escapes through the holes. This happens when the force of water is at least equal to two atmospheres. This experiment has been repeatedly tried, and varied in different ways, with the same uniform result.

The preceding, and the problem of the cards, I consider as cases precisely similar; the same effect produced by the same cause. I therefore, in a concise form, gave a similar explanation, which was published in the United States Gazette some weeks since.

I have since seen a solution of the latter problem by Professor Hare, who attributes the effect to a different cause. He supposes that the blast coming out in various currents from the common centre of the tube and disks, causes an afflux of the surrounding air towards them, and as Mr. Perkins expresses it, (who explained the problem of the valve in the same way that Dr. Hare has that of the cards,) "impinges" on the whole outer surface of the disk, and counteracts the power of the blast, which acts only on a small part of the inner surface. To satisfy myself of the fallacy of this, I used means which I thought effectual to cut off all afflux of air towards the disk, which could have a tendency to keep them together, when I found the effect as prompt as before; which made me conclude, they were not kept together by any *flow* of air, but by the constant and steady *pressure* of the atmosphere which rested on them at the time the blast commenced, and continues unabated, while that on the inner surfaces is lessened by being met and opposed by the force of the blast, running out between the two inner surfaces of the cards.

I attempted to illustrate this by a tube six inches in length, and about the diameter of a large quill, at the end of which I fixed two strips of paper $\frac{3}{4}$ of an inch wide, and extending about three inches from the end of the tube; on blowing with force through the tube, the strips of paper were brought together by a very prompt and rapid movement. I observed the same effect, when this tube, with the strips of paper, was placed within another tube of $1\frac{1}{2}$ inch diameter and 10 or 12 inches long.

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*Account of the accident from lightning, which happened to the packet ship the New York. By* T. Trail Stewart, M. D., *of Liverpool. Read before the Royal Society, February 21st,* 1828.

We have already published an account of the accident narrated in the following paper, in our 4th vol. p. 197; but as this contains some particulars not mentioned in the former, we have determined to present it also. Some of the English Journals state the fact, that the elderly gentleman who "forgot his debility," walked home from the vessel upon her arrival in Liverpool, and has ever since retained the use of his limbs. Is it not more probable that this was the effect of electricity, than of terror from the crash? Editor.

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"The ship which met with the accident of which the effects are the subject of this communication, was the American packet the New York, of 526 tons, commanded by captain Bennet. She sailed from New York for Liverpool, on the 16th of April, 1827; and on the morning of the 19th was struck by lightning, which shattered the main royal mast, and gliding down the iron chain main-top-sail tie, burst the iron bands on the main mast head. It was thence conducted

by the iron main-top-sail sheets, to the iron work of the pumps. It then entered between decks, demolishing the bulkheads that form the store-room, in its way to a small leaden cistern: whence it was conducted, by a leaden pipe, through the starboard side of the ship, where it started three five-inch planks, ten feet in length, at the lower part of the bends. Many other parts of the ship, not in the direct line of its passage, were also shattered, apparently from the effects of a lateral explosion, several doors and partitions were thrown down, a large mirror in the cabin was shivered into small fragments, and a piano-forte was thrown down, its top torn off and broken in pieces. The loudness of the explosion was appalling, and spread universal consternation. A sulphurous smoke, which had issued with a bluish flame from the hatches, filled the cabins; and at first inspired alarm, lest the cargo in the hole, consisting chiefly of cotton and turpentine, had taken fire; but on clearing the main hatch, it was soon ascertained that no danger from fire existed. The ship however had sprung a leak, which made four inches of water every hour, but which on washing the pumps was found to be under command, and would not prevent her proceeding on her voyage to England.

"When the first terror created by the accident had somewhat subsided, it was found that none of the passengers or crew had sustained any injury. The chief mate was sleeping in the birth opposite to the main-hatch, near the spot where the lightning entered the store-room, the lock of which was forcibly driven into his cabin: but he was not himself affected by the shock; and a quantity of gunpowder which was kept under his bed, was fortunately not ignited by the lightning. An ewer and a basin placed on a stand over a child's bed, were thrown down by the explosion, but the child had escaped unhurt. A remarkable effect was however produced on an elderly gentleman, who for the last five years had not been able to walk half-a-mile at a time: terrified by the crash, he forgot his debility, and springing from his bed, rushed on deck with singular quickness and agility. He has retained, ever since the event, the power over the muscles of his limbs, derived from this sudden emotion.

"The threatening aspect of the heavens, the appearance of numerous water-spouts on the surface of the sea, and other electrical indications, gave rise to apprehensions of further danger, and induced the captain to put up the conductor with which he was provided, but which had not been previously applied. It was made of iron links eighteen inches long, connected by iron rings an inch in diameter; and was furnished at the top with an iron rod four feet long, and half an inch in diameter, tapering to a fine point. This rod was fixed so as to rise three feet above the main royal mast head; and the chain was made to descend along the back-stay, and below was kept at a distance of ten feet from the starboard bulwarks by a light wooden outrigger, or spar. Its whole length was 145 feet, of which about nine feet of its lower part descended into the sea. The wisdom of adopting this precaution was soon apparent, for in the course of the same morning, the ship was struck by a second explosion, which is

stated by the unanimous testimony of all on board, to have far exceeded the first in violence. It melted a great part of the conductor, producing a vivid combustion of many of the links, which burnt like so many tapers; and descending into the sea, darted off to a considerable distance along the surface of the waves. The resistance to its passage was so great as to cause the ship to recoil with a sudden and violent shock, so as to throw down several of the crew. The melted iron of the conductor fell in large drops on the deck, which, already strewed with hail-stones that had previously fallen, intermixed with rain, was set fire to in many places by the ignited metal. No damage, however, was done to the masts or rigging, nor the least injury to any of the crew, with the exception of a carpenter, who being at work with an iron auger in his hand, received a smart shock through the wrists, which occasioned a vivid tumour, which was still visible six weeks after the accident.

"Soon after the arrival of the vessel in Liverpool, she was docked, in order to ascertain what damage she had sustained. Some of her planks were found to have started, but her timbers were uninjured. Every instrument made of steel, such as the carpenter's tools, and the knives and forks; and also those made of soft iron, even to the very nails in every part of the ship, had been rendered permanently magnetic. All the watches and chronometers, were either stopped or rendered useless, by the magnetism imparted to the balance wheels and other parts of their works that were made of steel. Contrary to what usually happens from shocks of artificial electricity, the lightning had given a strong northern polarity to the upper part of the conductor. Many parts of the iron-work, indeed, had acquired the magnetism corresponding to their position with respect to the magnetic direction; but in others, no relation of this kind could be traced. Great changes were produced on the magnetism of the compass needles, in many of which were formed several sets of poles, and their indications could therefore no longer be relied on.

"The circumstances attending the accident which is the subject of this paper, are considered by the author, as strongly confirming the value of conductors to ships in obviating the destructive effects of lightning. From the inquiries he has made, he is led to the belief, that injuries from lightning at sea, are much more frequent than is generally imagined. One source of increased danger of late years is to be found in the greater proportion of metal, and particularly of iron, which is employed in the rigging; more especially as the metallic masses are there nearly insulated, or connected only by very imperfect conductors. In the instance before us, it is in the highest degree probable, that if the New York had been without the protection of the conductor, she must inevitably have been destroyed by the second tremendous explosion, which, thus guarded, she sustained without the slightest injury. The author remarks, that copper is a better material for such a conductor than iron, from its being less liable either to fusion or corrosion; and also, that a rod is, from its continuity, a better form of conductor than a chain. In the case of ships, however, the greater convenience of a chain, arising from its

flexibility, will generally insure it the preference. The author recommends, that, instead of carrying the conductor through the decks to the keel, as suggested by Mr. Harris, the lower end of the chain should be kept at a distance from the sides of the ship, by means of a light outrigger, or spar, as was done in the New York."

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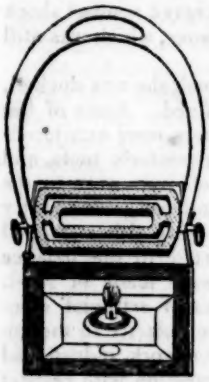
## *The Stirrup Lantern.*

[To the Editor of the Register of the Arts and Sciences, &c.]



Sir—Being an old traveller of the equestrian order, and having experienced much comfort and convenience from the use of the Stirrup Lantern, I am desirous of recommending it to the notice of travellers generally, through the medium of your interesting work.

The Stirrup Lantern is a small square lantern, fixed at the bottom of a stirrup by means of two screw rings on each side, as exhibited in the drawing which accompanies this; they serve also to unscrew it whenever it may be required to detach it from the stirrup. The lamp part is so contrived that no oil can be spilt; nor the steady light, which is thrown across the road before the horse's feet, be at all impaired by any motion of the horse. The front part, as shown in the drawing, is of glass, through which is seen the lamp, burner, and wick; behind these is placed a reflector, for transmitting the light to the front. It is supplied with a constant current of air by means of apertures, in a sort of double casing, which are so disposed as to prevent any gust of wind from affecting the light.

This is not, Mr. Editor, an article of mere luxury, but one which confers the most solid comfort to the way-worn, benumbed, and benighted traveller. I make no doubt, indeed, that the Stirrup Lantern will be the means of saving many a neck from being broken; that my own is still entire is frequently a matter of wonder, when I consider how 'many a time and oft' I have been precipitated into hedges and ditches by some unlucky step of my horse.

In conclusion, I think it necessary to state, for the information of my brethren of the Stirrup, that I procured my apparatus of the inventor, Mr. Peat, of Piccadilly.

I am, sir, your obedient servant and constant reader,

P. Prynne.

*Lambeth, 14th January*, 1824.

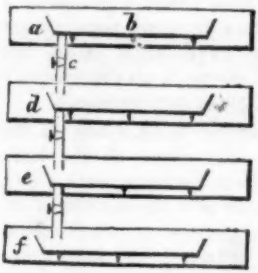
We think the Stirrup Lantern would be found particularly useful to medical practitioners in the country, when they have occasion to visit their patients at night. [*Ed. Reg. of Arts.*

## *New Process for Rectifying Spirit.*

TO THE EDITOR.

Sir—The alkaline salts have been, I believe, employed for the rectification of spirit, as long since as the time of the learned Boerhaave, and have been adopted by all succeeding chemists, and by distillers, as the only means of obtaining absolute alcohol. A most important improvement upon this mode of rectification, without heat, it is said, has recently been made by a French chemist.

The process, I am told, consists in placing a quantity of dry muriate of lime, or other deliquescent salt, in a large, shallow, covered vessel; in this is placed another vessel of smaller dimensions, and resting on the bottom upon short legs, containing the diluted spirit (brandy, for instance) to be concentrated; the outer or larger vessel is then covered down and properly luted, to prevent the escape of the spirit. A series of similar double vessels are then arranged underneath the former, charged with the muriate of lime only; and pipes of communication leading from one to the other, are furnished with stop cocks. Those arrangements, as well as the process, will be perfectly understood upon reference to the annexed diagram.




*a* is the first vessel containing the deliquescent salt, *b* that containing the dilute spirit. The cover of *a* being well closed and luted, it is left for several days for the salt to attract the water from the spirit; and when the former is supposed to be fully saturated with the aqueous particles, the spirit in *b* (considerably improved in strength) is drawn off into *d*, by turning the cock *c*. This second vessel being also provided with a stratum of muriate of lime, the process of concentration recommences, by a further abstraction of the water contained in the spirit. In like manner the spirit may be successively operated upon by the salts contained in the vessels *e* and *f*, and if required by any additional number of vessels, until alcohol of the greatest purity is obtained.

As each vessel is successively emptied of the spirit, the saturated salt is taken away, and replaced with a fresh quantity of the dry salt, when it is ready to operate upon another portion of spirit let on from above.

W. W——N.

*Paris.* [*ib.*

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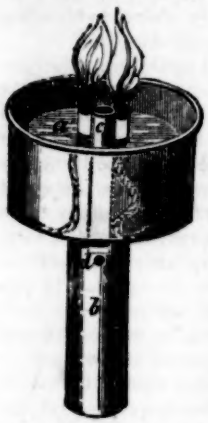
## *Lamp for Burning Tallow and other concrete fatty substances.*

The first proposal for burning tallow in the manner of oil, which we recollect to have met with, was made by the late Mr. William Nicholson, in the first volume of his Philosophical Journal, (quarto series.) In the third volume of the same work, there is a drawing and description of a lamp for this purpose, invented by Mr. William

Close; and since that period, (1797,) numerous plans have been devised, and some patents taken out for improvements in the process. The circumstances which render such a lamp desirable, are the economical use of the fat of our kitchen, the obtaining a light without the necessity of the constant snuffing required by candles, the lessening the danger of spilling, incident to the oil lamp, and the procuring a flame from tallow for certain operations in the arts, in which it is found to be more advantageous than that produced by oil; this is particularly the case in blowing glass with the lamp.

In Vol. 4. p. 412, we have described and figured the Hon. E. Cockrane's lamp for dissolving and burning fat; one of a more simple construction has been communicated by a correspondent to the Register of Arts, who says, "It is now more than twenty years ago that I made a lamp of this kind, by which I burned tallow, dripping, goose-grease, and other solid oily matters, very effectually and conveniently; of the construction of which, I here annex a perspective sketch, should you deem it worthy of a place in your popular and interesting work. It is a simple cottage candlestick lamp, but lamps on the same principle are capable of being rendered elegant: the addition of a glass chimney would be a great improvement.




"*a* is the fat rendered fluid, lying in the body of the lamp; (the cover of the lamp being removed to show the interior;) *c* is a small tube to convey air into the middle of the flame (to perfect the combustion, on the principle of the argand burner;) this tube opens at the lower end into the large tube *b*, as shown by dots; a small perforation is also made at *d*, to allow the air to flow freely into the tube *c*, when the lamp is fixed in the socket of a candlestick. On each side of the air tube a short piece of copper pipe is fixed by hard solder, for holding the cotton wicks; these tubes (which ought to be longer) get intensely hot, and, by the conducting power of the metal, the heat is transmitted to the fat, which, melting in consequence, flows up the wick like fine oil, but infinitely preferable, on account of its diffusing no unpleasant smell during the combustion."

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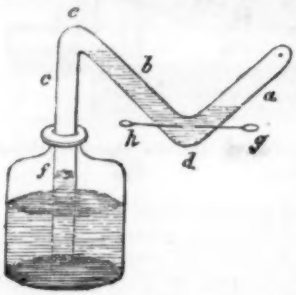
*An Account of Mr.* A. Robertson's *simple Apparatus for collecting Gases evolved from Liquids submitted to Galvanic Action. Communicated by the Author to the Edinburgh New Philosophical Journal.*

This apparatus consists of a glass tube of any size, divided into three parts, *a b c*, in the annexed figure, by the two bendings *d e*.

The upper end is closed, and the lower immersed in the fluid contained in the bottle; *f g h* are platinum wires, inserted through the tube near the bending *d*.

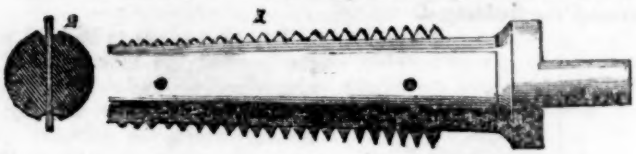



To use it—it is to be held with the part of the tube, marked *a*, nearly perpendicular, the open end being upwards, and the liquid, through which the galvanic electricity is to be transmitted, is poured in till the tube be filled. A slip of paper, a little broader than the diameter of the tube, is now to be placed over the orifice, and being extended on both sides along the tube, is to be held there, so that the whole may be inverted, without spilling into the bottle, *f*, previously half filled with the same fluid. The wires, *g h*, are then connected with the galvanic poles; and when the experiment is finished, the gas evolved at the wire, *g*, will be collected in the part of the tube, *a*, and that from the wire, *h*, at *c*, in the manner represented in the figure, the displaced fluid descending into the bottle.

The volumes of the gases may be ascertained by graduations on the tube, or they may be separately transferred into small jars, by the aid of a pneumatic trough; the gas at *c* ascending into one jar upon the tube being turned up, while the gas at *a* occupies the part of it on each side of the bend, *d*; and this, afterwards, upon a proper inclination of the tube, also ascends into another; so that each of them may be examined by itself. Should it be wished to re-combine them, it may be done without removing them from the tube, but by holding it so that the gas at *c* may rise to *b*, and join that in it, and then transmitting the electric spark between the wires.

The advantages of this apparatus, when water or any other fluid, not corrosive, is to be decomposed, consist in its simplicity and cheapness, as, by the aid of a blow-pipe, it may be made in a few minutes from any piece of glass tube of a proper size; and it possesses, also, every convenience of those which are more complicated and expensive. From the points of the wires within it being so near each other, the galvanic action is procured in its greatest intensity, and the products from each wire are, nevertheless, separately obtained. But when corrosive fluids are used, such as the nitric acid, (a substance well fitted for illustrating the action of galvanism in effecting decomposition, on account of the rapidity with which the affinity of its elements is thus overcome,) it is much more decidedly superior. The quantity of liquid used is comparatively small; there is a greater facility of filling or emptying, without coming in contact with the corrosive matter; and from there being only one opening it is more manageable, and there is much less risk of the fluid escaping from the vessels and being thrown about by the pressure of the gas produced.

*Description of Mr. Siebe's Tap for cutting hollow screws.*



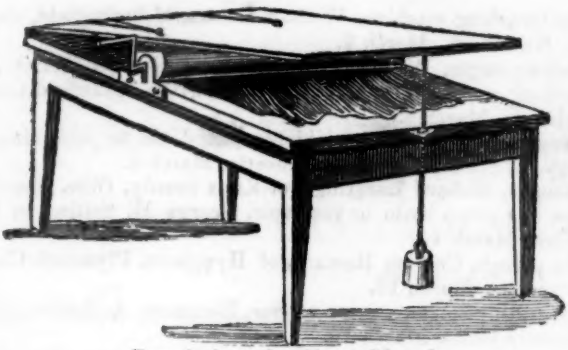

[Abstract from the Transactions of the Society for the Encouragement of Arts, &c.]

Screws vary from each other, not only in magnitude, but in the direction and complication of their threads; hence there are right and left-handed screws; also, single, double, and treble screws. The apparatus of Mr. Siebe enables the workman, with the same tool, to form either right or left, single, double, or treble hollow screws of the same diameter. The screws capable of being made by this implement are far from being mathematically accurate, but will be found to be quite as good as the hollow screws made in the usual way, and adapted to the use of various wooden articles of domestic furniture, and to the common kinds of machinery.

The Tap is a thin quadrilateral piece of steel, of the length and breadth of the required screw, having its longitudinal edges cut into saw teeth; the teeth in one row being opposite to the intervals in the other, and therefore representing a section of a screw, the teeth being sections of the threads. A cylinder of hard wood is turned, so as to correspond with the dimensions of the intended screw, and a longitudinal piece being sawn out from the middle, representing a section through the axis, the serrated plate is to be inserted, and firmly rivetted into its place. The cylinder terminates in a flat head, for the purpose of *receiving a key*, or lever, which enables the workman to overcome the friction experienced in cutting the screw.

In order to use this tool, a cylindrical hole, equal in diameter to the cylindrical stem, is to be bored in a piece of wood, and the serrated cylinder being then introduced, giving it a circular or spiral motion, will form a right or left-handed screw, according to the direction in which it is turned; and by entering two or three threads at once by means of the common V tool, the same Tap will give a double or treble threaded screw.

The hard wood being first made into a screw, the blade is rivetted in, and the teeth are made, by a file, to fit the wooden threads; the blade is then removed, the threads in the wooden cylinder are then turned off, leaving the stem a smooth cylinder; the blade is then tapered at the point so that the first teeth are no bigger than the cylinder; it is then rivetted again in its place, and the instrument is complete, as exhibited in fig. 1. Fig. 2 is an end view of the same, which is exhibited to show that the cylinder is cut away a little, where the teeth are inserted, to make room for the shavings; as the cylinder fits the hole, and the blade is taper, a gradual and steady cut is secured, which may either be to right or left hand.



*Description of a Cheap Mangle.*

The above is a sketch of a simple apparatus, which answers the purpose of a *Mangle*. It consists of a roller, about four inches in diameter, and thirty inches long, with a piece of the thick woollen cloth used for ironing upon, firmly fixed thereon, which is held upon a table by two strong iron plates, and turned round by means of a winch; upon this rests a board, the length and width of the table, secured to it at one end with hinges, and with a weight suspended from it at the other, the pressure of which, upon turning the winch, winds the woollen cloth, and the damp linen articles laid upon it, so tight upon the roller, that by continuing the motion, the linen becomes as smooth as by the common unwieldy mangle. The roller rests upon the table, and the iron plates allow it to rise or fall, according to the quantity of clothes wrapped round it.

[*Ed. Reg. of Arts.*

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## AMERICAN PATENTS.

*List of Patents granted in the United States, in March and April,* 1828.

FOR INVENTIONS AND IMPROVEMENTS.

In the grist mill, Samuel Holland, of Hanover, Columbiana County, Ohio, March 1.

In the thrashing machine, Michael First, Union Town, Maryland, March 3.

In the cooking stove, Daniel G. Garnsey, of Pomfret, Chanutaugue County, New York, March 3.

In making carriage bodies, called self-bracing bodies, Jesse Reeder, of Lebanon, Warren County, Ohio, March 4.

In the mode of curing tobacco, Martin Baker & Thomas Baker, of Louisa County, Virginia, March 4.

In the lever for working horse mills, &c. John Galbraith, of Maury County, Tennessee, March 6.

In making tongs of cast iron, Enos H. Buell, of Marlborough, Connecticut, March 6.

In the thrashing machine, William Looms, of Springfield, Oswego county, New York, March 6.

In making sugar, William J. M'Intosh, of Georgia, March 7.

In making paper, Wm. Magaw, of Meadville, Crawford County, Pennsylvania, March 8.

In the machine for raising vehicles, called *the tar jack*, Hezekiah Salisbury, of Springfield, Massachusetts, March 8.

In ploughs, Richard Loveridge, of Knox county, Ohio, March 8.

In the tide pump basin or reservoir, George M. Selden, of Troy, New York, March 10.

In the plough, Charles Howard, of Hyngham, Plymouth County, Massachusetts, March 10.

In generating steam, gas, or vapour, Ebenezer A. Lester, of Boston, Massachusetts, March 10.

In water power to the propelling of machinery generally, George Morgan Gibbs, of Prince William Parish, Beaufort District, S. C., March 10.

In the machine for bending sheet iron for steam engines, boilers, &c., Calvin Post, of Spring Port, Cayuga County, New York, March 11.

In manufacturing cast iron shoes, for sleighs, &c., Ichabod Arnold, of Oswegatchie, New York, March 12.

In the grist mill, Admiral Warren, Saugerties, Ulster County, New York, March 12.

In the machine for boring rocks, Israel Overall, of Liberty, Smith County, Tennessee, March 14.

In carriages, Thomas Knox, of Sniggersville, Loudon County, Virginia, March 15.

In the application of steam, Joseph Skinner, of Mantua, Portage County, Ohio, March 14.

In propelling boats or carriages, Timothy Davis, of Lawrence, Dearborn County, Indiana, March 15.

In the construction of wash-stands, John Williams, Baltimore, March 15.

In the trip hammer, Levi Rosenkrans, of the town of Big-flat, Tioga County, New York, March 17.

In the machine for shelling corn, John Brown, Providence, Rhode-Island, March 18.

In piano fortes, C. F. L. Albrecht, of Philadelphia, March 18.

In moulding and finishing bricks, David Flagg, jr., Gardiner, Maine, March 21.

In the washing and churning machine, Rufus R. Palmer, Caroline Township, Tompkins County, New York, March 21.

In the satinett power loom, Richard Mitchell and Nathaniel Butterworth, Troy, Bristol County, Massachusetts, March 22.

In the mode of applying the archimedian screw in raising water, Perry Harris, of Preble County, Ohio, March 25.

In the evolution and management of heat, Eliphalet Nott, of Schenectady, New York, March 26.

In grinding bark, called the bark grinder, Aaron Bull, Caroline, Tompkins county, New York, March 27.

In the washing machine, do. do. March 28.

In boring pump logs and aqueducts, Samuel Draper, of Camillus, Canandagua County, New York, March 31.